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United States Patent [19]

Campbell

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[45] Date of Patent: Jan. 19, 1999

[54] **CONTAINER SEAMING APPARATUS AND METHODS**

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[73] Assignee: **ABC Seamer Technologies, Inc.**, Aston, Pa.

[21] Appl. No.: **996,874**

[22] Filed: **Dec. 23, 1997**

[51] **Int. Cl.**[6] **B21D 51/26**

[52] **U.S. Cl.** **413/6**; 413/27; 413/31

[58] **Field of Search** 413/2, 3, 4, 5, 413/6, 7, 31, 40, 41, 43, 27, 26; 53/334, 338, 488, 486, 485

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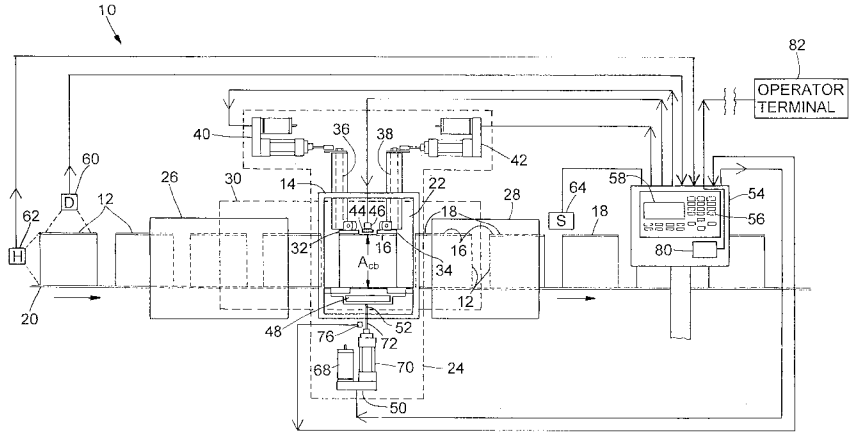
Primary Examiner—James F. Coan

Attorney, Agent, or Firm—Panitch Schwarze Jacobs & Nadel, P.C.

[57] **ABSTRACT**

A container seaming machine has a first drive for positioning a seaming roller with respect to a circumferential edge of the lid, and a second drive for rotating the seaming roller with respect to a container lid chuck, container body and container lid. The first drive and the second drive are independently controllable from each other, and each drive is controlled and coordinated by a programmable controller to seam the lid to the container body. Another drive, also controlled by the programmable controller, lifts the container body toward the chuck and allows for varying degrees of force to be exerted between the container body and the lid. The drives use servomotors and linear actuators for precise positioning control. A process for displacing air from containers prior to seaming a lid to a container is also provided. In the process, a container body is filled with contents and is then injected with liquid nitrogen. A lid is immediately placed on the container body, and a biasing force is immediately applied against the lid to maintain the lid on the liquid nitrogen filled container bodies until the container body reaches the seaming mechanism. The biasing force is sufficient to allow a portion of nitrogen gas from vaporization of the liquid nitrogen to escape from the container body, and to allow air originally present in the container body to escape from the container body, while preventing surrounding air from entering the container body.

42 Claims, 13 Drawing Sheets



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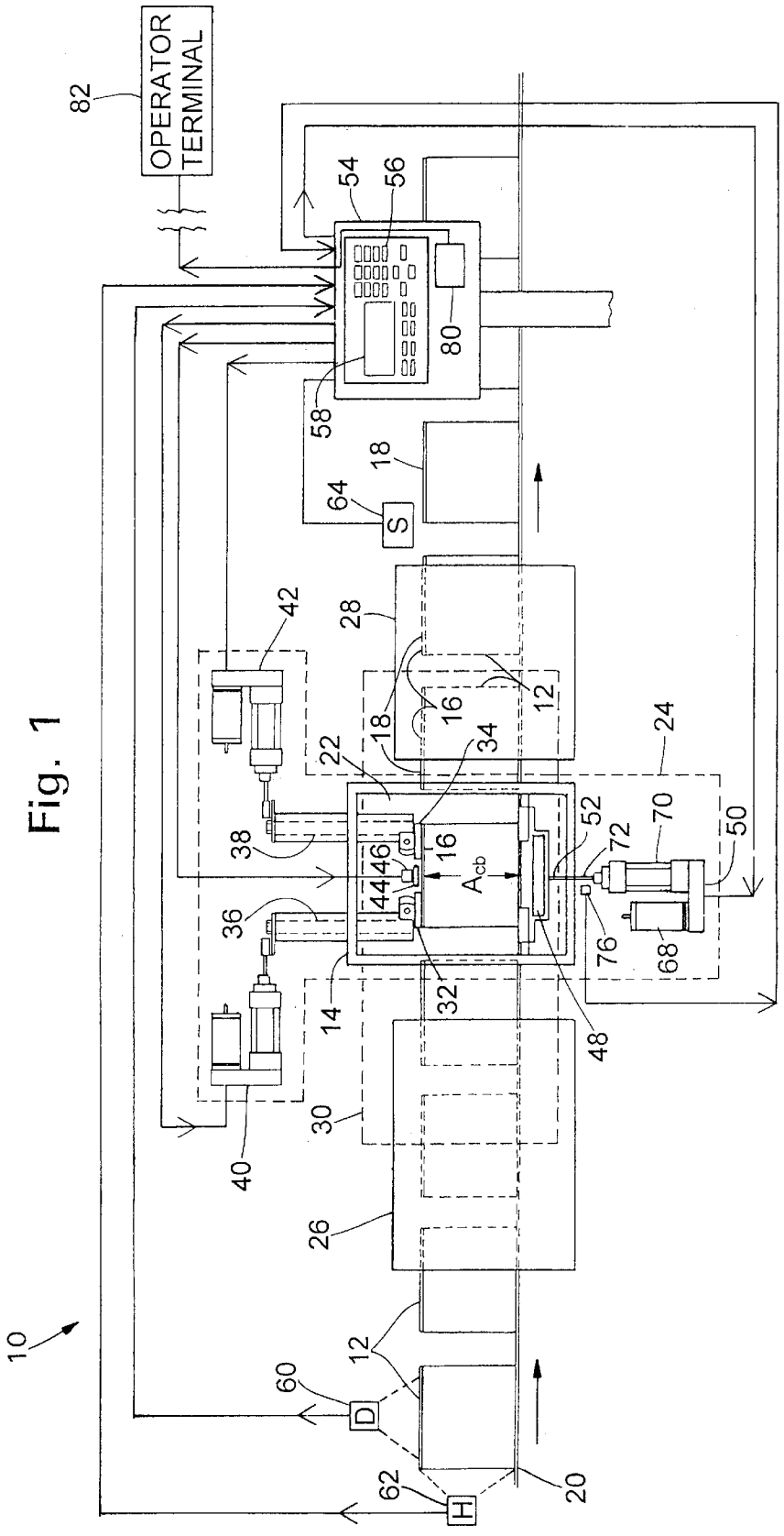
OPERATOR TERMINAL
82
54
56
80
58
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28
12
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22
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44
46
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A_{cb}
52
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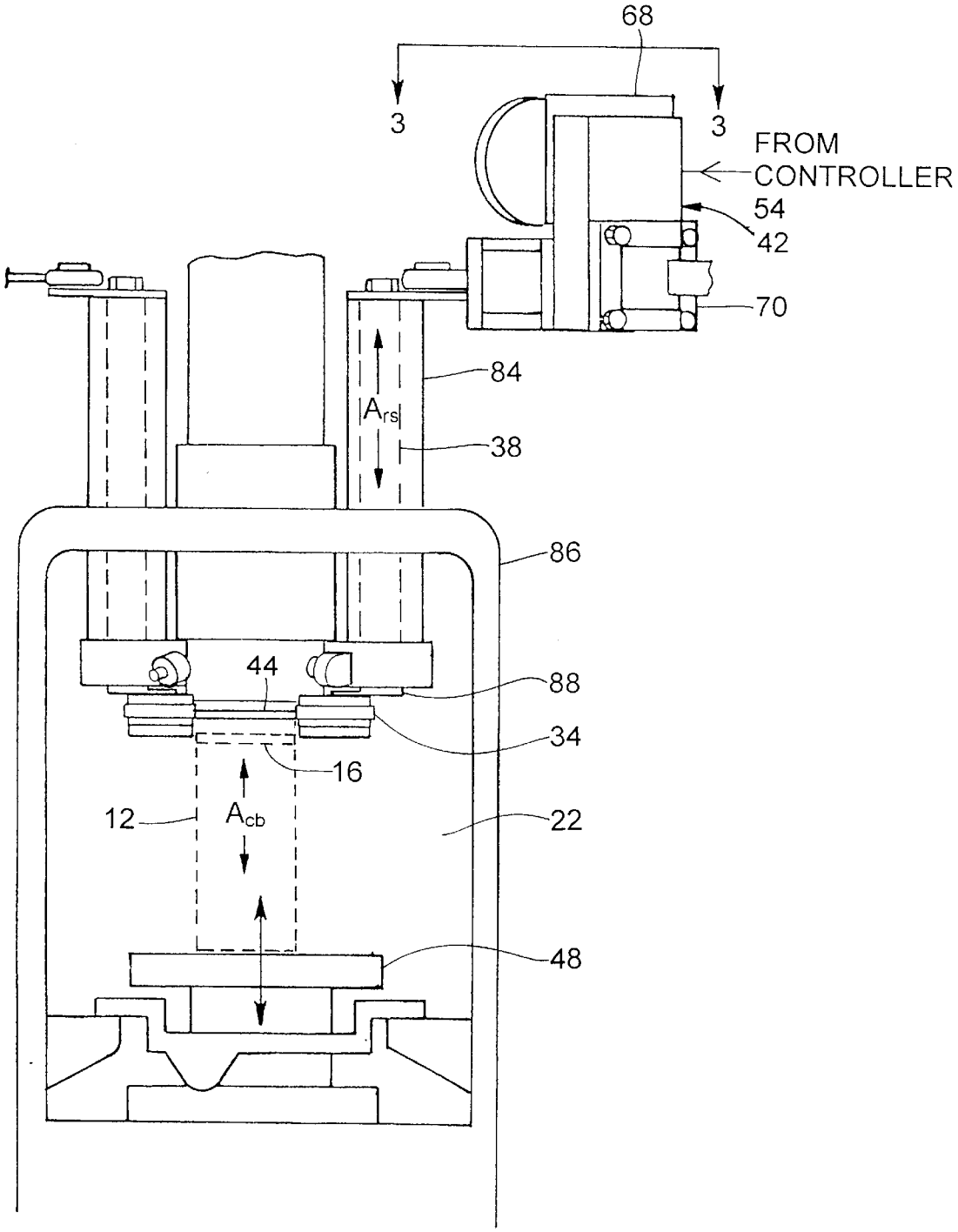
20

Fig. 1

Fig. 2


68
3
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FROM
CONTROLLER
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A_{rs}
38
86
44
88
34
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A_{cb}
22
48

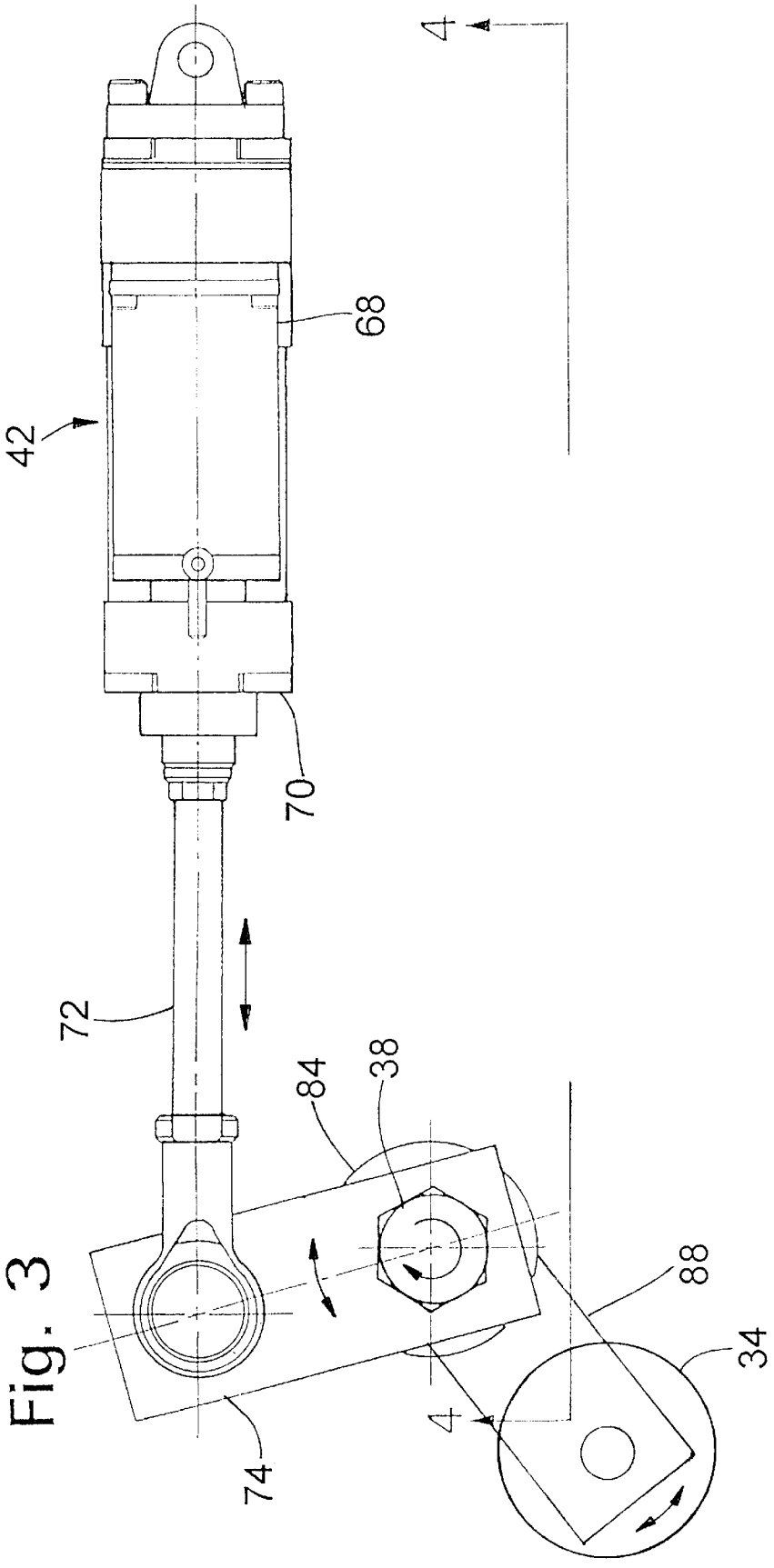


Fig. 3

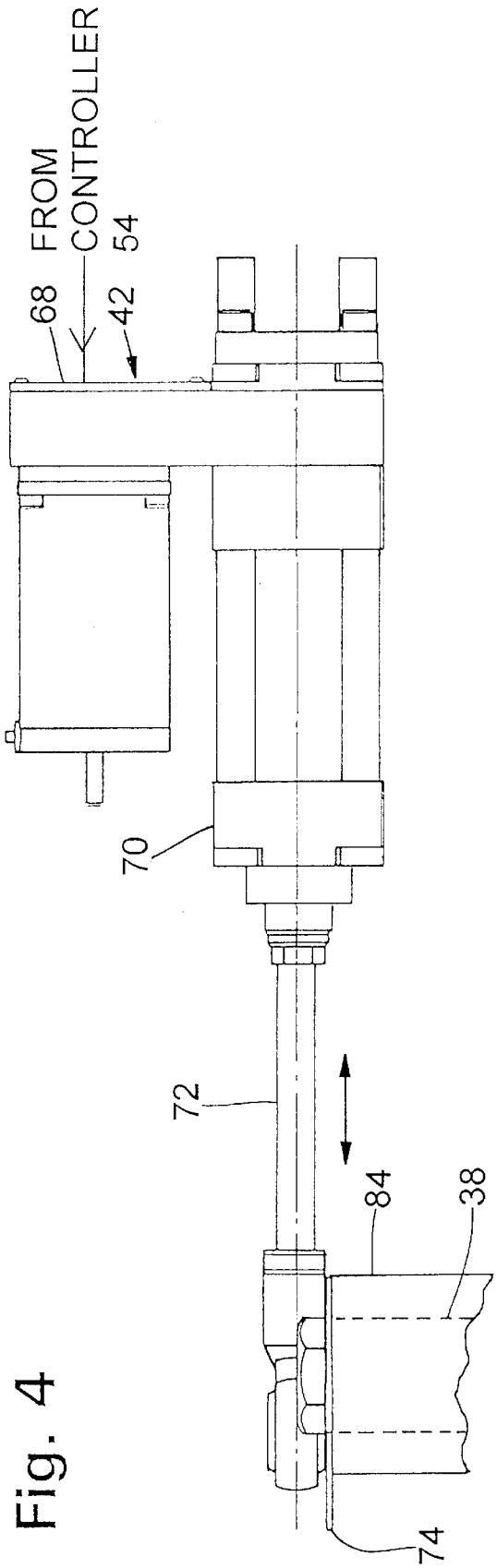


Fig. 4

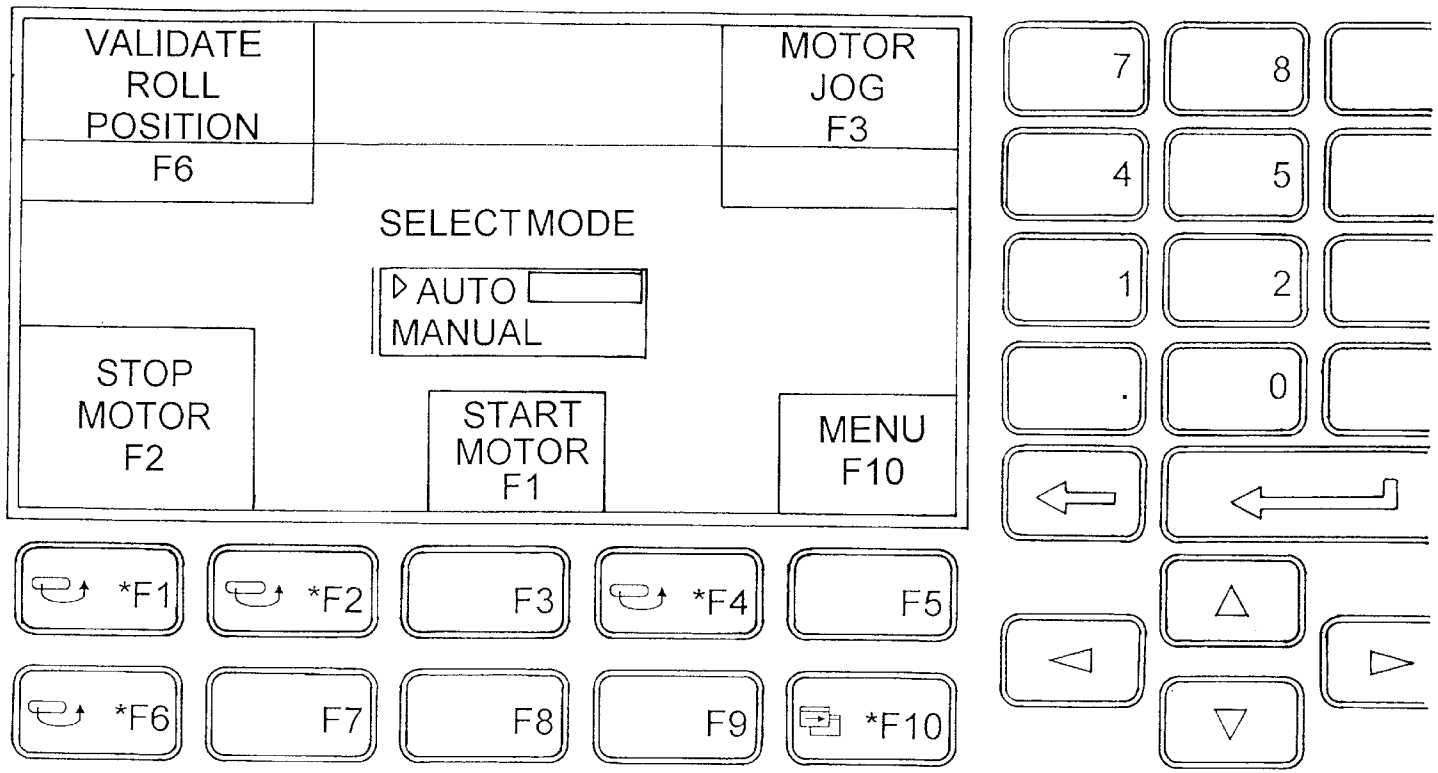


Fig. 5A

Screen Summary Report

Screen 1 - Motor Status

ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
203,	Motor_Jog,	Momentary Push Button,	(192, 0),	(64, 48),	On ,	On ,	F4
214,	,	Goto Screen Selector,	(208, 96),	(48, 32),	On ,	On ,	F10
218,	Machine_AutoManual,	Control List Selector,	(96, 64),	(75, 23),	On ,	Off	
318,	,	Text,	(88, 48),	(85, 10),	On ,	Off	
829,	Validate_Roll_Position,	Momentary Push Button,	(0, 0),	(80, 48),	On ,	On ,	F6
860,	Motor_Stop,	Momentary Push Button,	(0, 80),	(64, 48),	On ,	On ,	F2
921,	Motor_Start,	Momentary Push Button,	(112, 96),	(48, 32),	On ,	On ,	F1

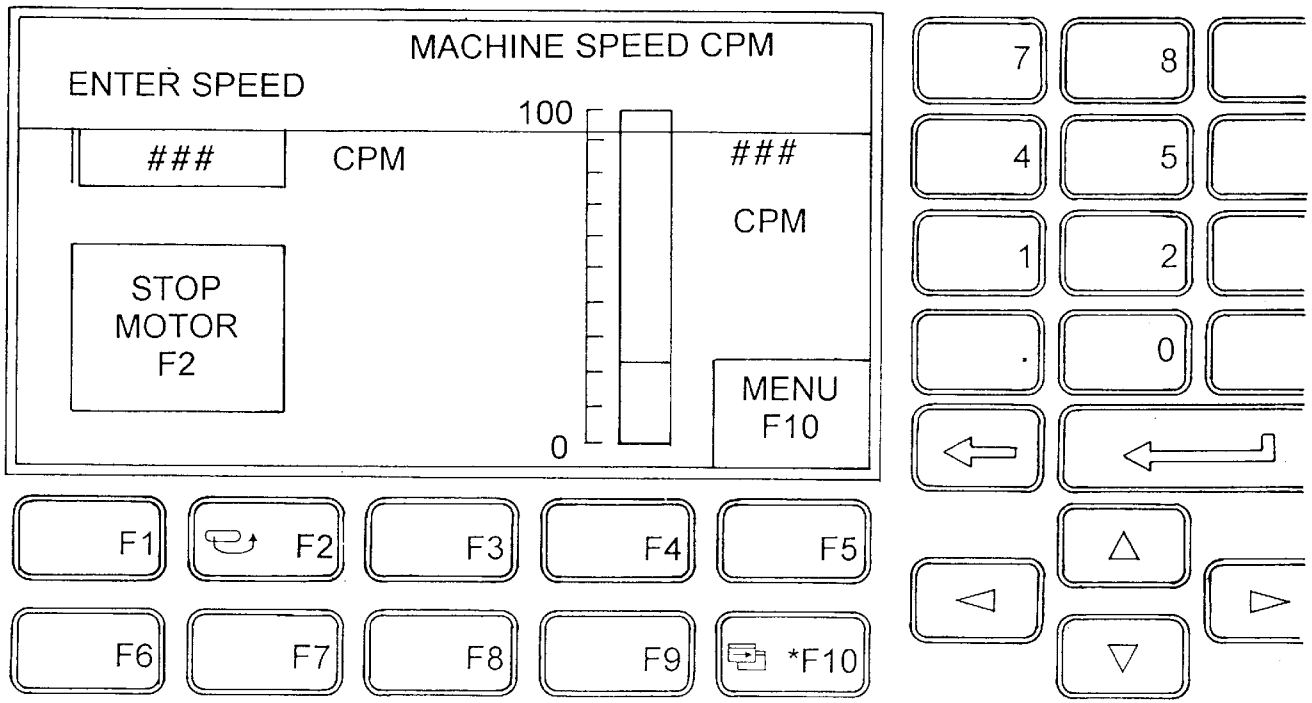


Fig. 5B

Screen Summary Report

Screen 2 - Motor Speed

ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
348,	,	Goto Screen Selector,	(208, 96),	(48, 32),	On ,	On ,	F10
351,	Motor Speed_Ind,	Bar Graph,	(180, 25),	(16, 96),	On ,	Off	
353,	,	Scale,	(170, 25),	(5, 96),	On ,	Off	
355,	,	Text,	(135, 25),	(27, 10),	On ,	Off	
360,	,	Text,	(150, 115),	(17, 13),	On ,	Off	
363,	,	Text,	(115, 0),	(112, 16),	On ,	Off	
371,	motor_speed,	Numeric Entry Cursor Pt,	(16, 32),	(64, 16),	On ,	On	
376,	,	Text,	(15, 15),	(72, 10),	On ,	Off	
384,	,	Text,	(90, 35),	(32, 10),	On ,	Off	
388,	Motor_Speed_Ind,	Numeric Data Display,	(205, 30),	(43, 15),	On ,	Off	
399,	,	Text,	(210, 50),	(32, 15),	On ,	Off	
860,	Motor_Stop,	Momentary Push Button,	(16, 64),	(64, 48),	On ,	On ,	F2

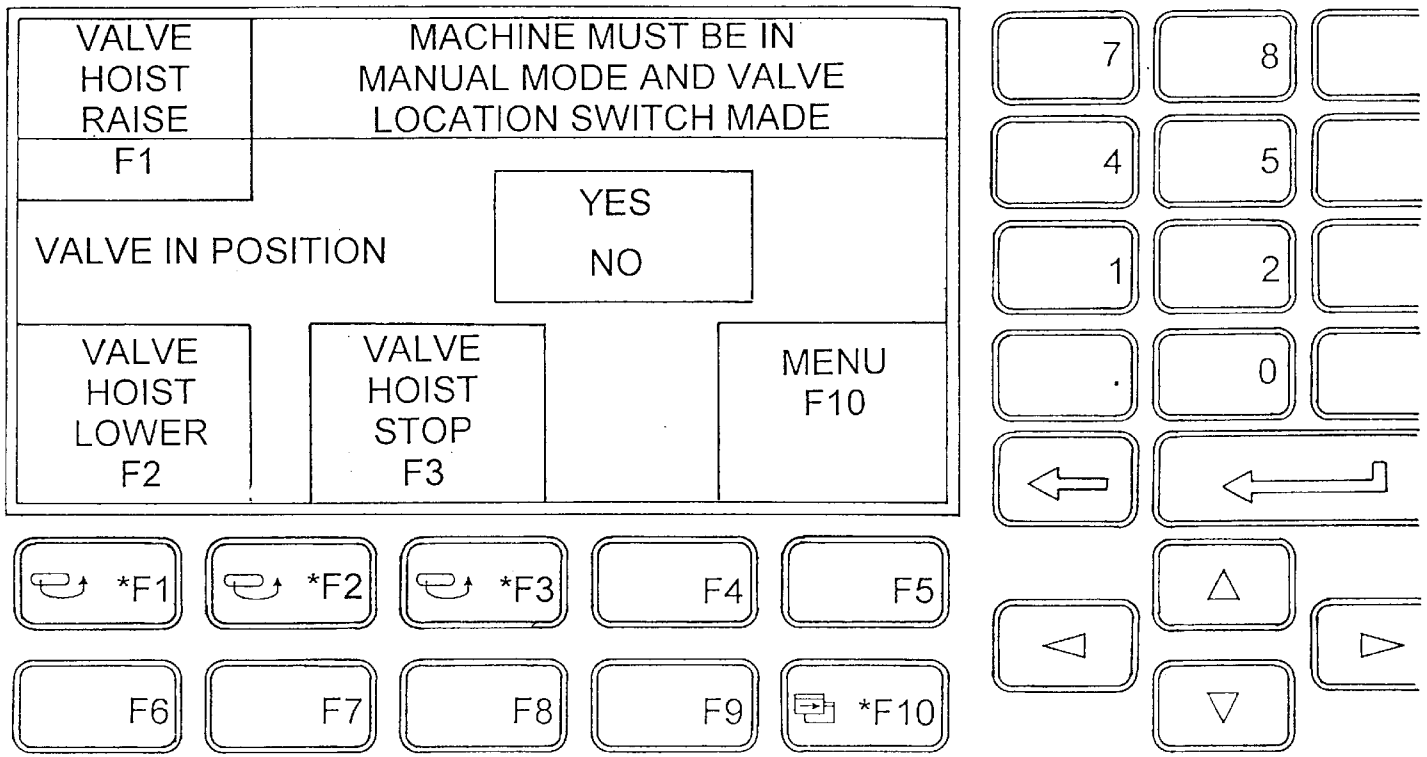


Fig. 5C

Screen Summary Report

Screen 3 - Valve Service

ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
403,	Valve_Hoist_Raise,	Momentary Push Button,	(0, 0),	(64, 48),	On ,	On ,	F1
426,	Valve_Hoist_Lower,	Momentary Push Button,	(0, 80),	(64, 48),	On ,	On ,	F2
437,	valve_hoist_stop,	Momentary Push Button,	(80, 80),	(64, 48),	On ,	On ,	F3
448,	,	Goto Screen Selector,	(192, 80),	(64, 48),	On ,	On ,	F10
451,	,	Rectangle Drawing,	(130, 40),	(72, 35),	On ,	Off	
453,	Valve_Pos_Ind,	Multistate Indicator,	(150, 45),	(30, 10),	On ,	Off	
471,	Valve_Pos_Ind,	Multistate Indicator,	(150, 60),	(30, 10),	On ,	Off	
481,	,	Text,	(0, 55),	(112, 16),	On ,	Off	
489,	,	Text,	(85 5),	(165, 30),	On ,	Off	

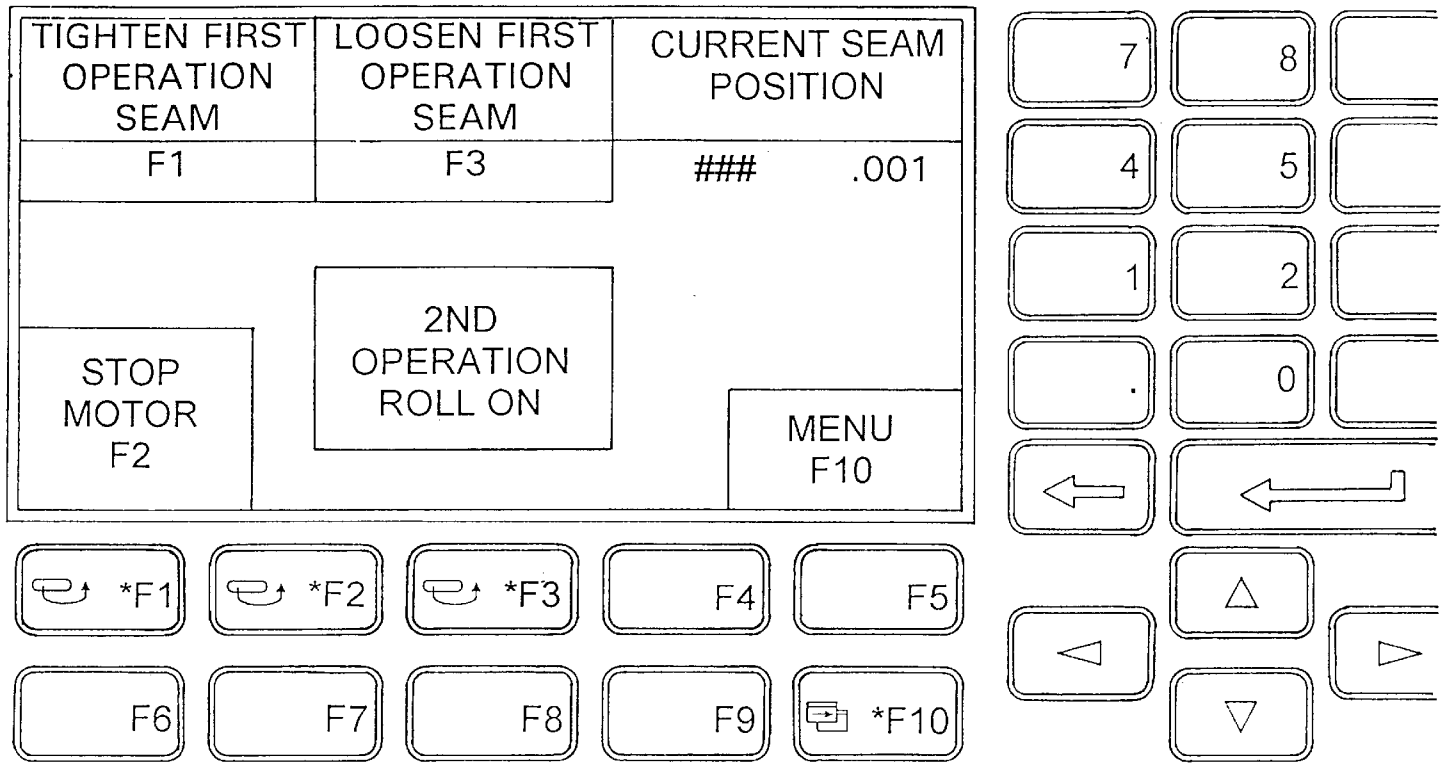


Fig. 5D

Screen Summary Report

Screen 4 -1 st. opper. adjustments

ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
498,	Tighten_1st_opp_seam,	Momentary Push Button,	(0, 0),	(80, 48),	On ,	On ,	F1
507,	Loosen_1st_opp_seam,	Momentary Push Button,	(80 0),	(80, 48),	On ,	On ,	F3
515,	,	Goto Screen Selector,	(192, 96),	(64, 32),	On ,	On ,	F10
551,	First_Seam_Ind,	Numeric Data Display,	(168, 32),	(48, 16),	On ,	Off	
557,	,	Text,	(216, 32),	(40, 16),	On ,	Off	
560,	,	Text,	(168, 0),	(88, 24),	On ,	Off	
860,	Motor_Stop,	Momentary Push Button,	(0, 80),	(64, 48),	On ,	On ,	F2
985,	Second_Opperation_On_Seam,	Maintained Push Button,	(80, 64),	(80, 48),	On ,	On	

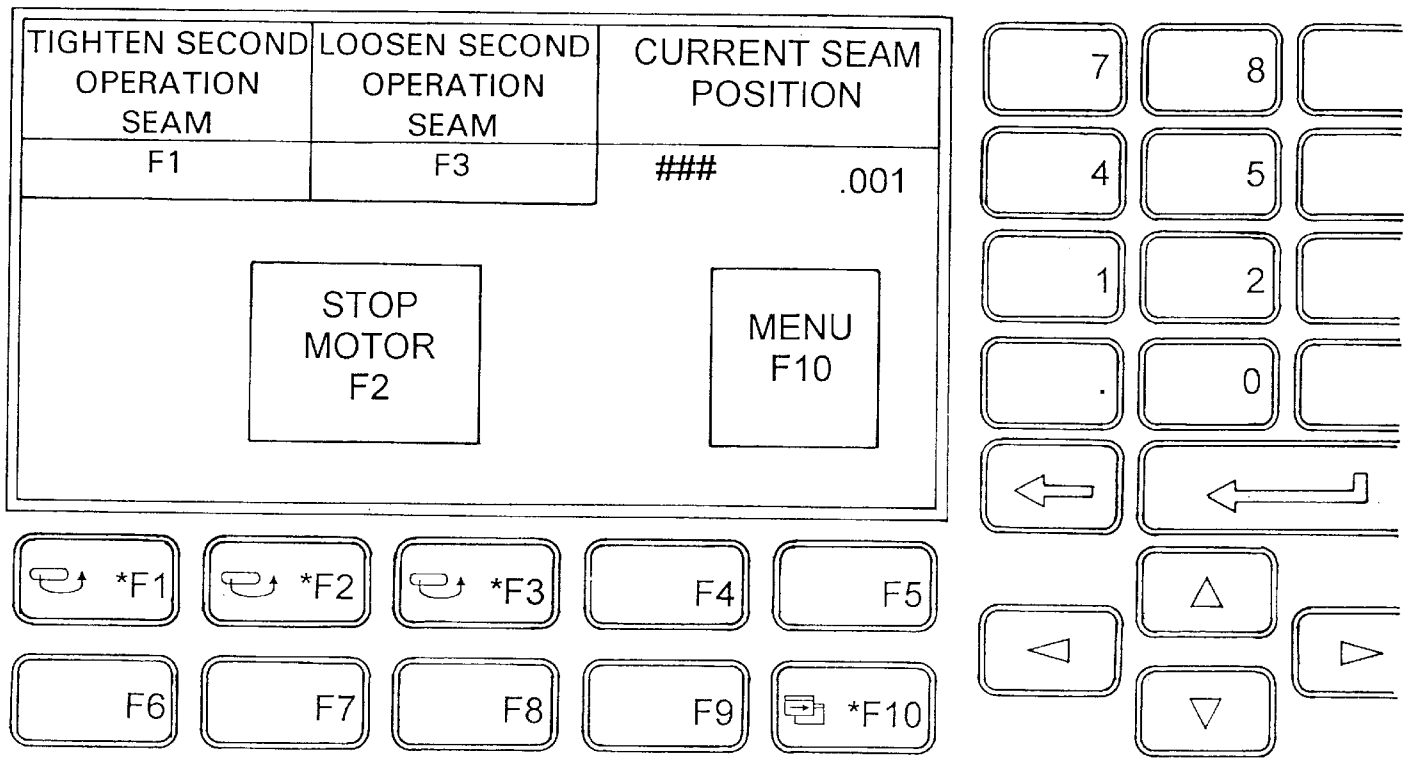


Fig. 5E

Screen Summary Report

Screen 5 - 2nd opper. adjustments

ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
575,	,	Text,	(170, 0),	(86, 24),	On ,	Off	
583,	Second_Seam_Ind,	Numeric Data Display,	(165, 30),	(43, 16),	On ,	Off	
588,	,	Goto Screen Selector,	(192, 64),	(48, 48),	On ,	On ,	F10
592,	,	Text,	(220, 35),	(35, 16),	On ,	Off	
596,	Tighten_2nd_opp_seam,	Momentary Push Button,	(0, 0),	(80, 48),	On ,	On ,	F1
604,	Loosen_2nd_opp_seam,	Momentary Push Button,	(80, 0),	(80, 48),	On ,	On ,	F3
860,	Motor_Stop,	Momentary Push Button,	(64, 64),	(64, 48),	On ,	On ,	F2

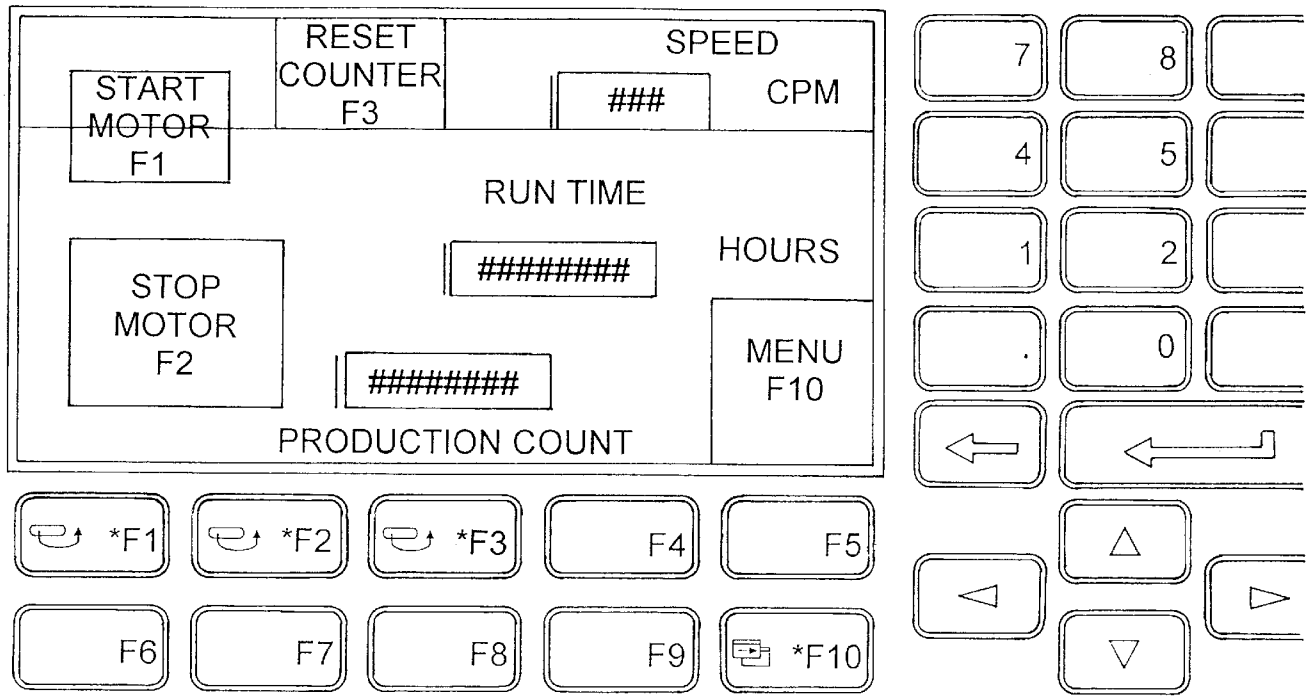


Fig. 5F

Screen Summary Report

Screen 6 - Machine Operation

ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
628,	Motor_Run_Time_Ind,	Numeric Entry Cursor Pt,	(128, 64),	(64, 16),	On ,	On	
633,	Motor_Speed_Ind,	Numeric Entry Cursor Pt,	(160, 16),	(48, 16),	On ,	On	
638,	Production_Ct_Ind,	Numeric Entry Cursor Pt,	(96, 96),	(64, 16),	On ,	On	
643,	,	Goto Screen Selector,	(208, 80),	(48, 48),	On ,	On ,	F10
666,	,	Text,	(205, 60),	(40, 15),	On ,	Off	
662,	,	Text,	(140, 45),	(55, 10),	On ,	Off	
674,	,	Text,	(75, 115),	(115, 13),	On ,	Off	
678,	,	Text,	(220, 15),	(30, 15),	On ,	Off	
682,	,	Text,	(180, 0),	(56, 10),	On ,	Off	
686,	Reset_Ct,	Momentary Push Button,	(80, 0),	(48, 32),	On ,	On ,	F3
912,	Motor_Start,	Momentary Push Button,	(16, 16),	(48, 32),	On ,	On ,	F1
860,	Motor_Stop,	Momentary Push Button,	(16, 64),	(64, 48),	On ,	On ,	F2

Fig. 5G

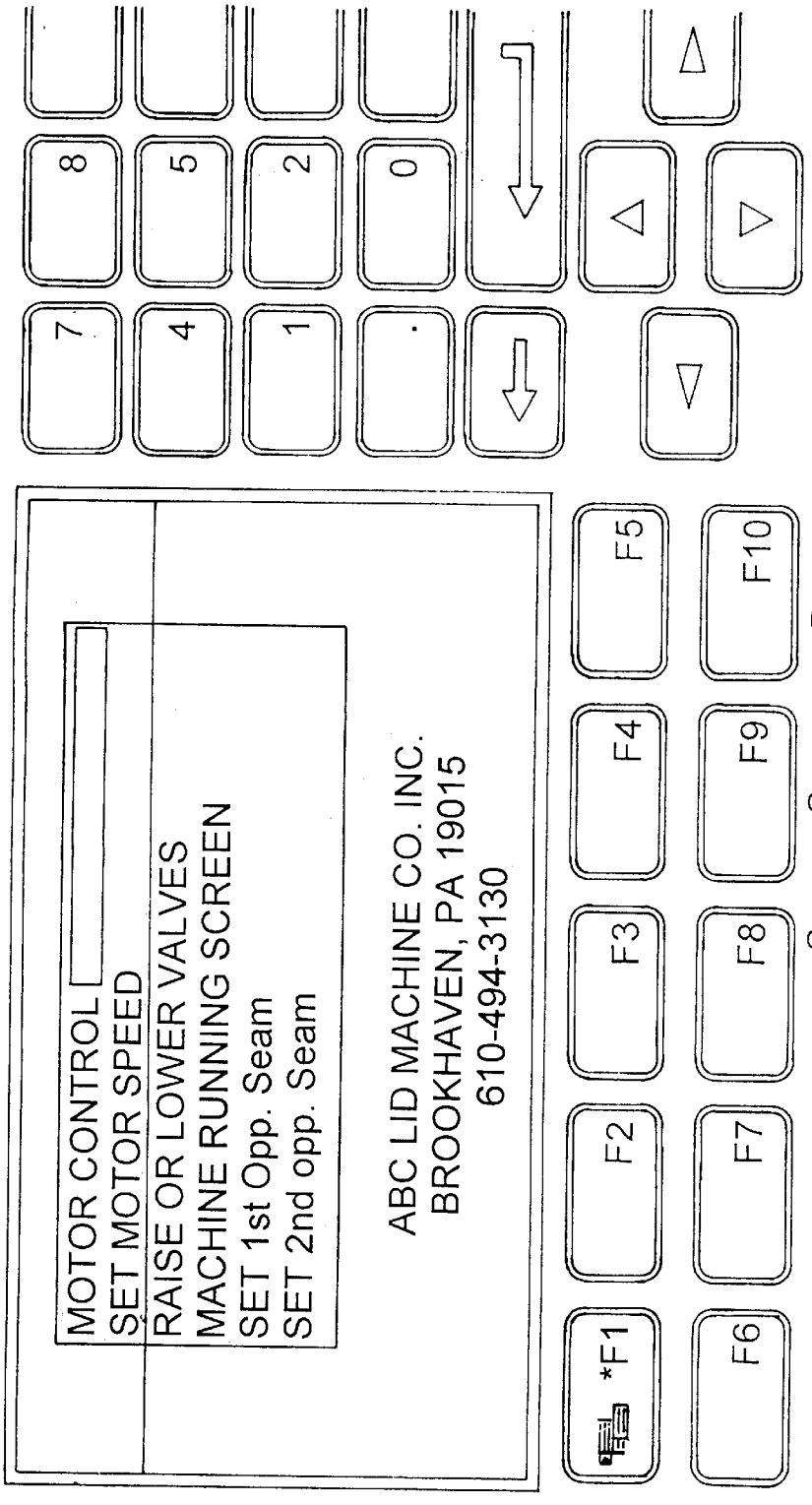

MOTOR CONTROL
SET MOTOR SPEED
RAISE OR LOWER VALVES
MACHINE RUNNING SCREEN
SET 1st Opp. Seam
SET 2nd opp. Seam
ABC LID MACHINE CO. INC.
BROOKHAVEN, PA 19015
610-494-3130
7
8
4
5
1
2
.
0
*F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
Screen Summary Report
Screen 7 -Screen List
ID, Tag Name, Object Name, Position, Outline, View, Touch, Fkey
695, , Screen List Selector, (32, 16), (192, 64), On , On , F1
955, , Text, (25, 90), (215, 35), On , Off

Fig. 5H

Screen Summary Report

Screen Alarm Banner ID,	Tag Name,	Object Name,	Position,	Outline,	View,	Touch,	Fkey
796,	,	Alarm Banner Drawing,	(0, 32),	(256, 96),	On ,	Off	
798,	,	Text,	(16, 40),	(224, 24),	On ,	Off	
802,	,	Clear Alarm Button,	(16, 80),	(48, 32),	On ,	On ,	F6
806,	,	Alarm Acknowledgment Button,	(192, 80),	(48, 32),	On ,	On ,	F7

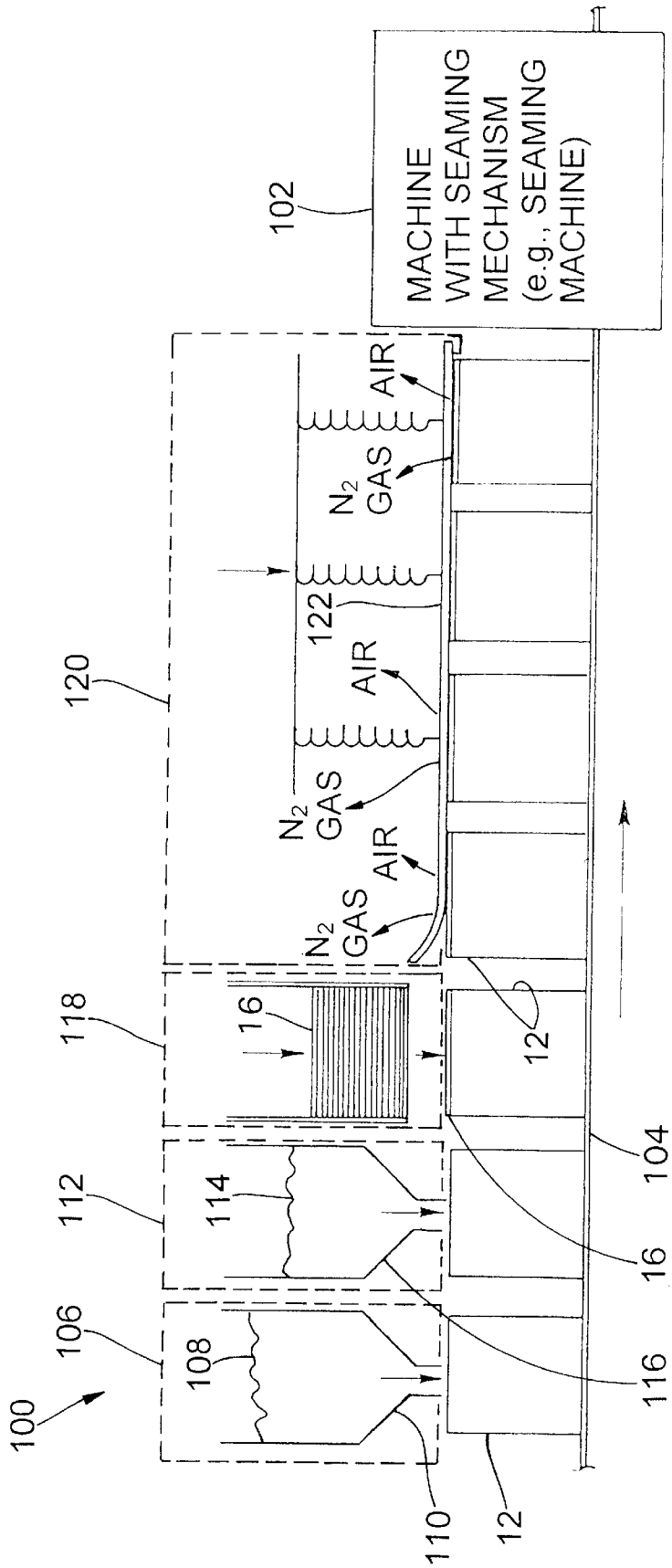

MACHINE WITH SEAMING MECHANISM (e.g., SEAMING MACHINE)
102
AIR
N_2 GAS
122
AIR
N_2 GAS
AIR
N_2 GAS
120
118
16
12
112
114
104
16
106
108
116
100
110
12

Fig. 6

CONTAINER SEAMING APPARATUS AND METHODS

BACKGROUND OF THE INVENTION

The present invention relates generally to seaming machines. A seaming machine is used to seam a lid to a contents-filled container body so as to form a sealed container. The seaming machine typically has two seaming rollers associated with the seaming machine to form a sanitary seam, also called a double seam, between the container body and the lid.

Conventional seaming rollers are positioned by mechanical cams controlled by mechanical drives, gear trains and the like, all of which are carefully coordinated and interlinked with a drive that rotates the container body with respect to the seaming rollers. Due to the complex linkages uses in conventional seaming machines and reliance on primarily mechanical drives, it is very time-consuming to make adjustments to a seaming machine when the machine becomes out of tolerance, or if a different size container is used. For example, it may take as long as an entire workday, as well as the swapping of parts, to change a machine if a different container size is used. The changeover results in lost production time and requires skilled, hard to find,, machine operators. A conventional seaming machine, by virtue of its inherent design, is also limited in the range of different container sizes that it can be adjusted to handle.

When packaging goods which spoil due to exposure to air, the air is removed from the container before the lid is sealed thereon. One process for removing the air and which avoids the necessity to seam under a vacuum, is to inject liquid nitrogen into the container before the lid is seamed onto the container. As the liquid nitrogen vaporizes, the resultant nitrogen gas drives out the air. This process requires precise timing to ensure that substantially all of the liquid nitrogen vaporizes and that no air leaks back into the container before the lid is seamed on. It is very difficult to achieve the precise timing.

Accordingly, there is a need for seaming machines and processes which overcome the problems discussed above.

BRIEF SUMMARY OF THE INVENTION

A container seaming machine is provided which includes a seaming chuck, a seaming roller and a first and a second drive. The seaming chuck holds a lid firmly against an end of a container body during a seaming operation. The first drive is connected to the seaming roller and positions the seaming roller with respect to a circumferential edge of the lid. The second drive causes rotation of the seaming chuck, thereby causing rotation of the container body and container lid. The first drive and the second drive are independently controllable from each other. A programmable controller provides the separate control and coordination of the two drives. A method of seaming a lid to a container body by using the container seaming machine is also provided. The first drive may include a servomotor and a linear actuator. The servomotor receives control data related to the desired position of the seaming roller with respect to the circumferential edge of the container body, and the container lid. The linear actuator translates a servomotor output to cause movement of the seaming roller.

Another embodiment of the invention provides a container seaming machine for performing a seaming operation on a container body and lid by using a seaming roller. The machine includes a seaming chuck, a base surface, a drive and a pressure sensor. The seaming chuck holds the lid

firmly against an end of the container body during a seaming operation. The other end of the container body is placed on the base surface. The drive causes the base surface to move toward the seaming chuck so that the end of the container body and the lid are held firmly against the seaming chuck and so that the container body and lid are in position for performing the seaming operation. The end of the container body and the lid exert a force against each other which is determined by the final position of the drive. In this manner, the final position of the drive is adjustable so that the drive may cause varying degrees of force to be exerted between the container body and the lid. The pressure sensor is associated with an output of the drive. The pressure sensor measures the force exerted between the container body and the lid. The measured force is used to determine the final position of the drive.

Another embodiment of the invention provides a process to displace air from containers prior to seaming a lid to a container. In the process, a container body is filled with contents and is then injected with liquid nitrogen. A lid is immediately placed on the container body, and a biasing force is immediately applied against the lid to maintain the lid on the liquid nitrogen filled container bodies until the container body reaches the seaming mechanism. The biasing force is sufficient to allow a portion of nitrogen gas from vaporization of the liquid nitrogen to escape from the container body, and to allow air originally present in the container body to escape from the container body, while preventing surrounding air from entering the container body. The biasing force is applied for a period of time which is sufficient to allow substantially all of the liquid nitrogen to vaporize, and thereby displace substantially all of the air originally present in the container body. The biasing force may be applied by a spring loaded rail. An apparatus for performing this process is also provided.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there are shown in the drawings embodiments which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

FIG. **1** is a schematic illustration of an assembly line process which uses a container seaming machine in accordance with the present invention;

FIG. **2** is an enlarged front elevational view of a portion of the seaming machine of FIG. **1**;

FIG. **3** is a top plan view of a seaming roller drive for the seaming machine of FIG. **2**, taken along line **3**—**3** of FIG. **2**;

FIG. **4** is an elevation view of the seaming roller drive of FIG. **3**, taken along line **4**—**4** of FIG. **3**;

FIGS. **5**A–**5**H are sample display screens and their respective screen summary reports for a programmable controller which is shown in FIG. **1** and which controls the seaming machine of FIG. **1**; and

FIG. **6** is a schematic illustration of an assembly line process for removing air from containers prior to seaming the containers, in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In the drawings, the same reference numerals are employed for designating the same elements throughout the several figures.

FIG. **1** shows an assembly line **10** for moving content-filled container bodies **12** through a seaming station **14** which seams lids **16** to the container bodies **12** to form lidded, sealed containers **18**. The assembly line **10** includes a conveyor **20** for moving the container bodies **12** and the seamed containers **18**. The seaming station **14** defines a vacuum chamber **22** having a seaming machine **24** therein. The individual components of the seaming machine **24** are described in detail below.

The container seaming machine **24** described herein seams lids to container bodies under a vacuum state. To accomplish this task, the assembly line **10** further includes an inlet or entrance feed valve **26** and a discharge or exit feed valve **28**, each of which have respective inlets and outlets in fluid communication with the seaming station **14**. The entrance feed valve **26** introduces the container bodies **12** to the vacuum chamber **22** of the seaming station **14**. Vacuum begins to be pulled on the container bodies **12** as the container bodies **12** pass through the feed valve **26**. The exit feed valve **28** removes the lidded, sealed containers **18** from the seaming station **14**.

The region of FIG. **1** labeled as **30** is a vacuum region, the highest vacuum occurring in the vacuum chamber **22**. Thus, while not illustrated in FIG. **1**, the outlet of the entrance feed valve **26** and the inlet of the exit feed valve **28** are in fluid communication with each other and are sealed from the surrounding environment. An integrated seaming mechanism which has an entrance feed valve **26**, a seaming station **14** under vacuum, and an exit feed valve **28** is conventional, and thus is not described in detail herein. One example of such a mechanism is a CANCO 117 seaming machine, made by Canco, Greenwich, Conn. The feed valves **26** and **28** in such a mechanism use turrets to move the container bodies **12** from the valve inlets to the valve outlets. The feed valves **26** and **28** may be similar to the feed valves in the Canco machine, or they may be similar to feed valves of other types of conventional vacuum-operated seaming mechanisms.

While the disclosed embodiment of the present invention seams under vacuum, the vacuum environment is not a necessary feature of the invention, and the seaming may occur at atmospheric pressure. Thus, the vacuum chamber **22** is optional, the feed valve **26** need not necessarily draw a vacuum, and the outlet of the feed valve **26** and the inlet of feed valve **28** need not necessarily be in fluid communication to maintain a vacuum. A less complex feed process may also be used in place of the feed valves **26** and **28** to deliver container bodies **12** to, and remove lidded containers **18** from, the seaming station **14**.

Seaming machines use seaming heads which have seaming rolls or seaming rollers attached thereto for performing the seaming function. In one type of seaming machine, a seaming chuck holds a lid firmly against a top end of a container body so that the lid is held in contact with the top end of the container body. A first mechanical drive positions the two seaming rollers with respect to a circumferential edge of the lid. A second drive on the seaming machine rotates the seaming roller with respect to the chuck, container body and container lid. There is typically one motor which has two power takeoffs, one for each of the drives. In one conventional configuration, the chuck, container body and lid remain stationary, and the second drive rotates the seaming roller around the container body and lid. In another conventional configuration, a second drive on the seaming machine rotates the chuck, which, in turn, rotates the container body and lid. There are typically two seaming rollers on a seaming machine used for food products. The two seaming rollers form a sanitary seam, called a double seam, between the container body and the lid. The first roller begins to roll the lid and the container body, forming a first operation roll seam, and the second roller completes the seam, forming the second operation roll seam. The resultant seam is airtight.

The seaming machine **24** has two such seaming rollers **32** and **34** linked to respective seaming roll shafts **36** and **38**. The rollers **32** and **34** are of conventional design, and thus not described in detail herein. The shafts **36** and **38** are described in detail below. While the seaming machine **24** has two seaming rollers, the present invention is equally applicable to a seaming machine which has only one seaming roller.

Conventional seaming rollers are positioned by mechanical cams controlled by mechanical drives, gear trains and the like, all of which are carefully coordinated and interlinked with the second drive that rotates the container body with respect to the seaming rollers. To change the settings of a conventional seaming machine, such as to accommodate a different container diameter or to correct a "seam out-of-tolerance" condition, the entire machine must be shut down and a very time-consuming resetting procedure must be performed. A changeover to a different container diameter may take several hours. Furthermore, conventional seaming machines typically require thousands of dollars of change parts to handle a different container sizes.

One important feature of the present invention is that the seaming rollers **32** and **34** are positioned by drives that are independently controllable from, or independent of, the drive that rotates the seaming rollers **32** and **34** with respect to a circumferential edge of the lid **16** to be seamed to the container body **12**. That is, the two drives are separate, mechanically unlinked motive means. There are no mechanical cams. Adjustments may be made to one drive without affecting the other. In this manner, the seaming roller drive (or seaming roller drives if there are two seaming rollers) may be positioned more easily, and without having to shut down the machine or adjust any gears or the like within the seaming machine. The seaming roller drives may even be adjusted while the seaming machine is in operation (i.e., "on-the-fly") and without having to stop the seaming machine at all. Furthermore, different container sizes may be run through the same seaming machine with a minimum of extra tooling.

The seaming roller drives must be coordinated with the drive that rotates the seaming rollers **32** and **34** with respect to a circumferential edge of the lid **16** to be seamed to the container body **12**. In the present invention, this coordination is performed by a controller, preferably, a programmable controller which executes a programmable logic control (PLC) program. The programmable controller provides significantly more flexibility than the conventional approach of mechanically synchronizing seaming machine drives.

Referring again to FIG. **1**, the seaming machine **24** includes a first seaming roller drive **40** and a second seaming roller drive **42**. The first seaming roller drive **40** is linked via the roll shaft **36** to the seaming roller **32**, and the second seaming roller drive **42** is linked via the roll shaft **38** to the seaming roller **34**. The drives **40** and **42** adjustably position the circumferential edge of the respective seaming rollers **32** and **34** toward and away from a center axis A_{cb} of the container body **12**, thereby positioning the seaming rollers **32** and **34** with respect to the circumferential edge of the lid **16** to perform a seaming operation.

The seaming machine **24** is of the type wherein a seaming chuck holds the lid **16** firmly against the top end of the

container body during the seaming operation, and a drive rotates the chuck, thereby causing rotation of the container body **12** and container lid **16** (and the chuck) in unison. The seaming chuck and drive are schematically shown and are labeled as **44** and **46**, respectively. The present invention may alternatively be used with a seaming machine **24** wherein a chuck, container body and lid remain stationary, and a drive rotates the seaming roller around the container body and lid. In either configuration, the first and second seaming roller drives **40** and **42** are independently controllable from the drive which rotates the seaming rollers **40** and **42** with respect to the chuck. In the disclosed example of the present invention, the first and second seaming roller drives **40** and **42** are thus independently controllable from the drive **46** that rotates the chuck **44**, as described in more detail hereafter.

The seaming machine **24** also has a vertically movable base surface or base plate **48** for receiving the container body **12** and for lifting it towards the chuck **44**. The base plate **48** is lifted by a base plate drive **50** which is linked via shaft **52** to the base plate **48**. In use, a container body **12** and an unattached lid **16** resting on the top end of the container body **12** are placed on the base plate **48**, and the container body **12** and unseamed lid **16** move toward the chuck **44** a predetermined vertical distance until the top end of the container body **12** and lid **16** are held firmly against the chuck **44**. The top end of the container body **12** and the lid **16** thus exert a force against each other which is determined by the final position of the base plate **48**, as determined by the action of the drive **50**. The container body **12**, lid **16** and chuck **44** remain in the final position during the seaming operation. After the seaming operation is completed, the base plate drive **50** moves the base plate **48** downward to allow the lidded container **18** to be released and to allow a new container body **12** to be placed on the base plate **48**. The base plate drive **50** is independently controllable from the roller drives **40** and **42**, and from the chuck drive **46**, as described in more detail hereafter.

In an alternative embodiment of the invention, the base plate **48** is fixed, and the chuck **44** moves vertically downward to hold the container body **12** and lid **16** firmly together against the base plate **48**. In this alternative embodiment, the drive **50** would be linked via the shaft **52** to the chuck **44**. In the preferred embodiment of the invention shown in the figures, the seaming rollers **32** and **34** do not move vertically. Accordingly, when a container body is properly positioned in the seaming machine **24**, it is only necessary to move the seaming rollers **32** and **34** toward the center axis of a container body **12** to properly position the rollers **32** and **34** to perform a seaming operation. However, if the fixed base plate alternative embodiment is used, it would be necessary to either link the seaming rollers **32** and **34** (and related parts) together with the vertically movable chuck **44** to obtain the proper vertical position for the seaming rollers **32** and **34** for the particular container height, or it would be necessary to independently move the seaming rollers **32** and **34** in a vertical direction using drives similar to the drive **50**.

The lid **16** is placed on the top end of the container body **12** before the two items enter the feed valve **26**. The mechanism for placing the lids **16** on the succession of container bodies **12** is not shown in FIG. **1**. In the embodiment of the invention which does not seam in a vacuum environment, the lid **16** is placed on the container body **12** before the two items are placed on the base plate **48**.

To allow for independent controlling of the respective drives, the assembly line **10** preferably includes a programmable controller **54** which executes a programmable logic control (PLC) program stored therein. A sample PLC program, shown as a ladder diagram, appears in the Appendix. Based on the program, control data is output from the controller **54** and sent to the respective drives **40**, **42**, **46** and **50**. One purpose of the programmable controller **54** is to appropriately position the seaming rollers **32** and **34** with respect to the circumferential edge of the lid **16** during rotation of the container body **12**, lid **16** and chuck **44** so as to perform a seaming operation. Another purpose of the programmable controller **54** is to control the base plate drive **50** so that the base plate **48** is lifted to the appropriate final position. The program thus coordinates the seaming operation in accordance with the stored program and thereby replaces conventional mechanical linkages which perform similar functions.

The programmable controller **54** includes an operator input panel **56** for allowing at least some of the operating values to be entered into the program, and a display **58** for interfacing with the operator during inputting and for communicating operating status. The programmable controller **54** may optionally receive input data from automated measuring devices or sensors placed along the assembly line **10**. For example, there may be a container body diameter sensor **60** and a container height sensor **62** located prior to the seaming station **14**. Data from these sensors may be used in place of an operator input values or preset values to set parameters of the program which will control the drives. In particular, the diameter sensor **60** may be used to control the roller drives **40** and **42** and the chuck drive **46**, whereas the height sensor **62** may be used to control the base plate drive **50**.

Roller drives **40** and **42** may periodically require fine position adjustments due to wear at contact surfaces or due to play in linkage components. An additional feedback sensor **64** may be located after the seaming station **14** to obtain data regarding the quality of the seam (e.g., its width, body hook and cover hook) of seamed containers **18**. The feedback data may be analyzed, compared to desired values, and used to make the fine position adjustments to the appropriate drives. Seamed containers may also be manually examined by quality control personnel, and based upon visual inspection, fine position adjustments may be manually entered into the operator input panel **56**.

Each production run of containers requires specific drive instructions based upon the container size (e.g., diameter and height), and desired qualities of the seam (e.g., width, body hook and cover hook). These factors are processed by the programmable controller **54** and used to create a set of instructions. The set of instructions are used to output drive control data for each of the seaming machine drives. For example, a container body having a three inch diameter and a six inch height requires a first set of instructions, including position instructions for the roller drives **40** and **42** (to appropriately position the seaming rollers **32** and **34**), rotation instructions for the chuck drive **46** and final position instructions for the base plate drive **50**, whereas a container body having a two inch diameter and a four inch height requires a second set of instructions that will be completely different from the first set of instructions.

The set of instructions may be initiated at the start of a production run of similar containers to be seamed in the same manner. Alternatively, the set of instructions may be modified during the production run based upon feedback data from the sensor **64**. Another alternative embodiment uses the diameter and/or height sensors **60** and **62** to define a new set of instructions "on the fly" without having to stop the seaming machine **24**. In this manner, a single production run may include containers of different sizes and/or seam types.

The container diameter may also be used to automatically select "on-the-fly" the appropriate chuck **44** from a plurality of chucks for automatic mounting to a seaming machine. The seaming machine **24** shown in the figures does not have this capability, although it could be provided, if desired. In this manner, a very wide range of container diameters can be processed continuously by the same seaming machine without requiring any downtime for manually changing chucks.

Since the programmable controller **54** has complete control over the drive **46**, and because the drive **46** is not mechanically linked to the drives **40** and **42**, the direction of the seaming process can be selected. In the seaming machine **24** of FIG. **1**, this means that the container body **12** can be spun in reverse during a seaming operation, if desired, thereby maximizing the strength of certain composite containers depending upon how the composite material is wound (e.g., clockwise or counterclockwise around a mandrel). Such composite containers would otherwise be weakened by a forward rotation during a seaming operation.

The programmable controller **54** also includes a remote communication module **80** for bidirectional communication with a remote operator terminal **82**. This allows an operator at a remote site to operate the seaming machine **48**, program or reprogram the controller **54**, and to remotely perform diagnostics.

To simplify the subsequent explanation of the invention, the seaming machine **24** is described with respect to only a single seaming roller and drive, particularly, seaming roller **34** and its corresponding drive **42**. The remaining discussion of these components is equally applicable to the seaming roller **32** and its drive **40**. Also, the position coordination of two seaming rollers with respect to each other which is required to create a double seam is well known and thus not described in detail herein. However, the process generally works as follows:

(1) The first roller is brought into contact with the lid, and begins to roll the lid and the container body. While the first roller is contacting the lid, the second roller is not in contact with the lid.

(2) Next, the first roller is moved away from (and out of contact with) the lid, and the second roller is brought into contact with the lid to complete the seam.

(3) When the seam is completed, the second roller is moved away from the lid.

FIGS. **2–4** show detailed views of one preferred embodiment of the drive **42** and its linkages to the seaming roller **34**. Referring to FIG. **2–4**, the drive **42** is linked via the roll shaft **38** to the seaming roller **34**. The roll shaft **38** is rotatable about its center axis A_{rs}. The roll shaft **38** rotates within a bushing (not shown) of a shaft housing **84**. The shaft housing **84** is fixed to a housing **86** of the seaming machine **24**. The drive **42** includes a servomotor **68** and a linear actuator **70**. The servomotor **68** has an input for receiving control data from the programmable controller **54** related to the desired position of the seaming roller **34** with respect to the circumferential edge of the container body **12** and the container lid **16**, and an output. The output of the servomotor **68** is connected to the linear actuator **70** which translates the servomotor output. The linear actuator **70** has an output shaft **72** which is pivotally connected to one end of a linking plate **74**. The other end of the linking plate **74** is fixedly secured to the top surface of the roll shaft **38**. Another linking plate **88** is fixedly secured at one end to the bottom surface of the roll shaft **38** and at the other end to the seaming roller **34**. In this manner, movement of the output shaft **72** out of the linear actuator **70** causes rotation of the roll shaft **38** in a counterclockwise direction, which, in turn, causes the seaming roller **34** to move toward the center axis A_{cb} of the container body **12**. FIG. **2** shows the seaming roller **34** in contact with the circumferential edge of the lid **16** and thus in the position for performing a seaming operation. Likewise, movement of the output shaft **72** into the linear actuator **70** causes rotation of the roll shaft **38** in the clockwise direction, which, in turn, causes the seaming roller **34** to move away from the center axis A_{cb} of the container body **12**. During a seaming operation, the seaming roller **34** rotates about its center axis in a conventional manner.

To obtain precise control of the drive **42**, the servomotor **68** is preferably a stepper motor which accepts control data from a programmable controller, and the linear actuator **70** is preferably a ball screw mechanism. Alternatively, the linear actuator **70** may be a pneumatic cylinder. Such servomotor and linear actuator combinations **68** and **70** are well-known to those skilled in the art. Accordingly, further description thereof is omitted for purposes of brevity and convenience only and is not limiting.

Poor seams are sometimes the result of insufficient or excessive force being applied between the container body **12** and the lid **16** during the seaming operation. Also, when the container bodies **12** are made of cardboard or a soft polymeric material, excessive force may cause crushing or bulging of the seamed container sidewalls. All of these problems can be minimized or eliminated by the present invention.

Referring to FIG. **1**, the drive **50** associated with the base plate **48** is preferably similar to the drive **42**, and thus also includes a servomotor **68** and a linear actuator **70**. However, the output shaft **72** of the linear actuator **70** associated with the drive **50** is directly connected to the shaft **52** which extends from the base plate **48**. The connection is along a common vertical axis. In FIG. **1**, the shafts **52** and **72** appear as one continuous shaft, even though there are actually two shafts linked together. Alternatively, the shaft **52** may be eliminated, and the linear actuator's output shaft **72** may be directly connected to the base plate **48**. This configuration allows for precise, computer-controlled height adjustments of the base plate **48**. As a result, the drive **50** is programmable to cause varying degrees of force to be exerted between the container body **12** and the lid **16**. Data obtained from the feedback sensor **64** may also be used to make fine adjustments to the final position of the base plate **48**.

To obtain even better control of the force exerted between the container body **12** and the lid **16**, a pressure sensor **76** may be associated within the drive **50** so that an immediate indication of the force may be detected and used for feedback control. In this scheme, a desired force is preset by the programmable controller **54**. In operation, the programmable controller **54** sends instruction data to the drive **50** to cause movement of the base plate **48** toward the chuck **44**. The output of the pressure sensor **76** is continuously transmitted to the programmable controller **54** and compared to the desired force. The comparison data is used to set the final position of the drive **50**.

The pressure sensor **76** may be a strain gage attached to the linear actuator's output shaft **72**. Alternatively, the pressure sensor **76** may be an air pressure sensor if the linear actuator **70** is a pneumatic cylinder.

Controller-driven drives provide significant advantages for the seaming machine **24**, some of which are discussed below.

It is sometimes desirable to spot clinch containers during a seaming operation. Spot clinching is performed on a seaming machine by intermittently engaging and disengag-

ing the seaming rollers from a seaming position during rotation of the seaming rollers with respect to the chuck, container body and lid. It is difficult, if not impossible, to use a conventional seaming machine for both spot clinching and complete airtight seaming. In one known technique, a rail substation is used when spot clinching with a conventional seaming machine.

The seaming machine **24** is easily adaptable to spot clinching, and to a combination of spot clinching and complete seaming operations. To perform spot clinching, it is only necessary to program the controller **54** with seaming roller engaging and disengaging instructions during rotation of the seaming chuck drive **46**. For example, if four clinches are desired, the controller **54** would be programmed to engage the seaming roller **34** at 0°, 90°, 180° and 270°. Since the seaming roller **34** is controlled independent of the seaming chuck drive **46**, it is not necessary to make any internal adjustments to the seaming machine **24** to perform spot clinching, to mix spot clinching and complete seaming operations in the same machine, or to perform spot clinching followed by complete seaming on the same container.

Preferred Components of Programmable Controller **54**

One preferred embodiment of the present invention is implemented using an SLC 500 programmable controller, equipped with preferably two Stepper Controller Modules. The SLC 500 programmable controller and the Stepper Controller Modules are both available from Allen-Bradley, Milwaukee, Wis. The output of the Stepper Controller Module provides the control data for the respective drives. A system overview of the SLC 500 family of programmable controllers is available from Allen-Bradley and has Publication No. 1747-2.30. A User's Manual for the Stepper Controller Module is available from Allen-Bradley and has Catalog No. 1746-HSTP1. Alternatively, one or three or more Stepper Controller Modules may be used, depending upon the needs of the overall system.

One preferred configuration of the SLC 500 programmable controller has the following components:

SLC 500 Modular Controller with an SLC 5/03 processor.

Memory Module—Catalog No. 1747-M1 12K Words

Power Supply—Catalog No. 1746-P2

24 VDC, 16 input Discrete Input Module—Catalog No. 1746-IV16

120/240 VAC, 16 output Discrete Output Module—Catalog No. 1746-OA16

VAC/VDC Relay, 16 output Discrete Output Module—Catalog No. 1746-OW16

I/O Analog Module—NIO4I and NIO4V

Operator Terminal—2711 PanelView 550 Operator Terminal,
Panelbuilder 550 Software

Remote communication module—1746-BAS Basic Module or 1747-KE Interface Module

The 1746-BAS Basic Module provides limited remote capability. The 1747-KE Interface Module provides full remote capability so that all of the functions of the programmable controller **54**, including the functions of adjusting drive instructions based on sensed container types and seam feedback data, can be performed remotely.

A sample ladder diagram for implementing seaming machine control via the Stepper Controller Module is shown in the Appendix. The ladder diagram performs the following machine control functions:

1. Configure the Stepper Controller Modules.
2. Start, stop and jog the seaming machine **24** (sends signal to AC motor inverter, also controls machine speed). This function also includes controlling power to the chuck drive **46** and the feed valves **26** and **28**.
3. Synchronize machine speeds and stepper motors.
4. Provide safety stops to protect machinery.
5. Track production and machine running hours.
6. Provide an interface with PanelView 550 Operator Terminal to allow for seaming roll adjustments.
7. Provide circuitry to allow valves to be raised and lowered for cleaning and maintenance.

Referring to function 2 above, the chuck drive **46** may also be controlled by a stepper motor which would require more precise control signals than power on/off signals used in the present embodiment of the invention.

Sample PanelView 550 display screens and their respective screen summary reports are shown in FIGS. **5A–5H**. These display screens may be generated using a PV550 Keypad and Touch Screen with software version FRN 2.00-2.xx, available as Allen-Bradley Catalog Part no. 2711-B5A3.

Components of Drives **40**, **42**, **50**

One family of drives which are suitable for use as the drives **40**, **42** and **50** are the ET Series Electro-Thrust Electric Cylinder, available from Parker Motion & Control, Parker Hannifin Corporation, Automation Actuator Division, Wadsworth, Ohio. Each of these drives have a ball screw and a stepper motor.

Rotations for Seaming Operation

One preferred embodiment of the invention requires a total of five container revolutions to seam a container, 2½ revolutions for the first (initial) seam and 2½ revolutions for the second (final) seam. The precise number of revolutions depends upon a myriad of factors, including the desired properties of the containers and the seams.

Liquid Nitrogen Injection

Many types of containers are seamed under vacuum so that the container interiors have substantially no air after they are seamed. In this manner, the container contents cannot become spoiled by exposure to oxygen in air trapped in the sealed container. Nuts are one product which is easily spoiled by exposure to oxygen. Seaming machines which operate in a vacuum environment, such as the seaming machine of FIG. **1**, are complex, expensive, and difficult to operate, compared to seaming machines which do not operate in a vacuum environment.

One technique that has been developed to avoid having to seam in a vacuum environment while still obtaining a substantially air-free container interior, is a liquid nitrogen injection process. In this process, a container body having a sealed bottom is filled with contents. Liquid nitrogen is then injected into the open top of a container body. The liquid nitrogen immediately begins to vaporize and drives out substantially all of the air (and thus substantially all of the oxygen) from the container body. The container body is then covered by a lid which may have a removable center foil seal, and the lidded container body is delivered to a seaming machine which seams the lid to the container body.

The conventional liquid nitrogen injection process suffers from many problems. One problem is that it is difficult to properly time the process so that at the exact time when the lid is seamed to the container body, (1) substantially all of

the air has been displaced so that the sealed container has less than about 2% oxygen, (2) all of the liquid nitrogen has vaporized, and (3) no surrounding air has flowed back into the container body. Referring to condition (1), if substantially all of the air is not displaced, the seamed container will have significant quantities of oxygen trapped therein which will accelerate spoilage of the contents. Referring to condition (2), if all of the liquid nitrogen is not displaced when the container is seamed, the vaporized nitrogen gas from the remaining liquid nitrogen will become trapped inside the container and will cause the container to visibly bulge. Consumers will not purchase visibly bulging containers, assuming that the contents are spoiled or defective. Referring to condition (3), if the container body is not seamed immediately after all of the liquid nitrogen has vaporized, the surrounding air will start to flow back into the container, thereby displacing a portion of the nitrogen gas. The resultant seamed container will contain a significant quantity of oxygen which will accelerate spoilage of the contents.

Another problem with the conventional liquid nitrogen injection process is that it is very wasteful of liquid nitrogen, primarily because the vaporization and air displacement process occurs in an open environment (i.e., no lid is on the container body).

FIG. **6** shows an assembly line process **100** which uses liquid nitrogen injection in accordance with the present invention to pack goods in seamed containers. Each container has a container body **12** and a lid **16** which are seamed together by a seaming mechanism of a machine **102** (typically, a seaming machine) located at the end of assembly line process **100**. Each container body **12** has a sealed bottom and an open top as it enters a conveyer **104** which moves the container body **12** through the assembly line process **100**. The assembly line process **100** comprises the following sequential steps which are applied to a succession of container bodies **12**:

(1) At a first station **106**, each container body **12** is filled with a predetermined quantity of goods **108** dispensed from a storage bin **110**. The storage bin **110** is illustrated in FIG. **6** as a hopper, but may be any type of storage facility which has a dispensing passage.

(2) At a second station **112**, each goods filled container body **12** is injected with a predetermined amount of liquid nitrogen **114** dispensed from a holding tank **116**. The predetermined amount of liquid nitrogen **114** is an amount which is sufficient to displace substantially all of the air which is originally in the container body **12**.

(3) At a third station **118**, the open top of each container body **12** is covered with a lid **16**.

(4) After each container body **12** exits the third station **118**, a lid holder **120** applies a biasing force against the lids **16** to maintain the lids **16** on the container bodies **12** until they reach the seaming mechanism of the machine **102**. One suitable lid holder **120** is a spring loaded guide rail **122** which simultaneously applies the biasing force to all lidded container bodies **12** traveling along the conveyer **104**. The biasing force is sufficient to allow a portion of nitrogen gas from vaporization of the liquid nitrogen, as well as air originally present in the container body **12**, to escape from the container body, while preventing surrounding air from entering the container body **12**. The lid holder **120** thus allows each of the lids **16** to act as a check valve for its respective container body **12**. In one suitable embodiment of the invention, the biasing force is no more than about three pounds of spring pressure on each container body **12**. The biasing force is selected to prevent the lid **16** from raising more than about ⅛ inches off the top of the container body **12** for a typical lid which has a vertical thickness of about ¼ inch.

Steps (3) and (4) are preferably performed in rapid succession and immediately after step (2). In this manner, the amount of liquid nitrogen **114** used in the process **100** is kept to a minimum because almost all of the vaporizing liquid nitrogen **114** is used to expel air trapped inside the lidded container body **12**.

Step (4) is performed for a period of time sufficient to allow substantially all of the liquid nitrogen **114** trapped within the container body **12** to vaporize, and thereby displace substantially all of the air originally present therein. Since the lids **16** act as check valves, there is no harm in exceeding this period of time. That is, as long as the biasing force continues to be applied, no air can reenter the lidded (but unseamed) container bodies **12**. As discussed above, a conventional liquid nitrogen filling process requires precise control between the time when liquid nitrogen is injected into the container body and the time when the seaming process occurs because air is free to flow back into the container body if all of the liquid nitrogen vaporizes before the container body has reached the seaming mechanism, and because a bulge may form in a container if the container body is seamed before all of the liquid nitrogen has vaporized. By freeing the process from the need for tight timing control, it is possible to improve the final results of the process (e.g., less bulging containers, less likelihood of high oxygen levels), while reducing its complexity.

Furthermore, the process **100** requires substantially less liquid nitrogen than conventional filling processes. A conventional filling process typically calls for filling container bodies with substantially more liquid nitrogen than is necessary to displace the air therein because the vaporization and air displacement occurs in an open environment (i.e., no lid). Accordingly, much of the nitrogen gas escapes from the container body throughout the displacement process. Also, ambient air constantly enters the container body throughout the displacement process, thereby adding to the total amount of ambient air that must be displaced. To compensate for these two factors, a significant quantity of extra liquid nitrogen must be injected to ensure that there is a sufficient amount of vaporizing liquid nitrogen so that the resultant sealed container has less than about 2% oxygen. In contrast to conventional liquid nitrogen filling processes, the amount of liquid nitrogen **114** required by the process **100** of FIG. **6** is an amount which is only slightly greater than the amount sufficient to displace substantially all of the air which is originally in the container body **12**. The amount must be slightly greater to account for some leakage as the container bodies travel between the second station **112** and the third station **114**, and between the third station **114** and the lid holder **120**.

An alternative embodiment of FIG. **6** may use a clincher as the lid holder **120**. The force applied by the clincher would meet the same criteria as the force applied by the spring loaded guide rail **122** discussed above.

To further enhance the efficiency of the process **100**, the container bodies **12** may optionally be heated from below during step (4) to drive out (i.e., vaporize) all of the liquid nitrogen **114**.

The preferred embodiment of the invention uses liquid nitrogen as the oxygen displacing gas. However, the scope of the invention includes processes which use other inert gases in place of some or all of the liquid nitrogen.

Retrofit of Conventional Seaming Machine

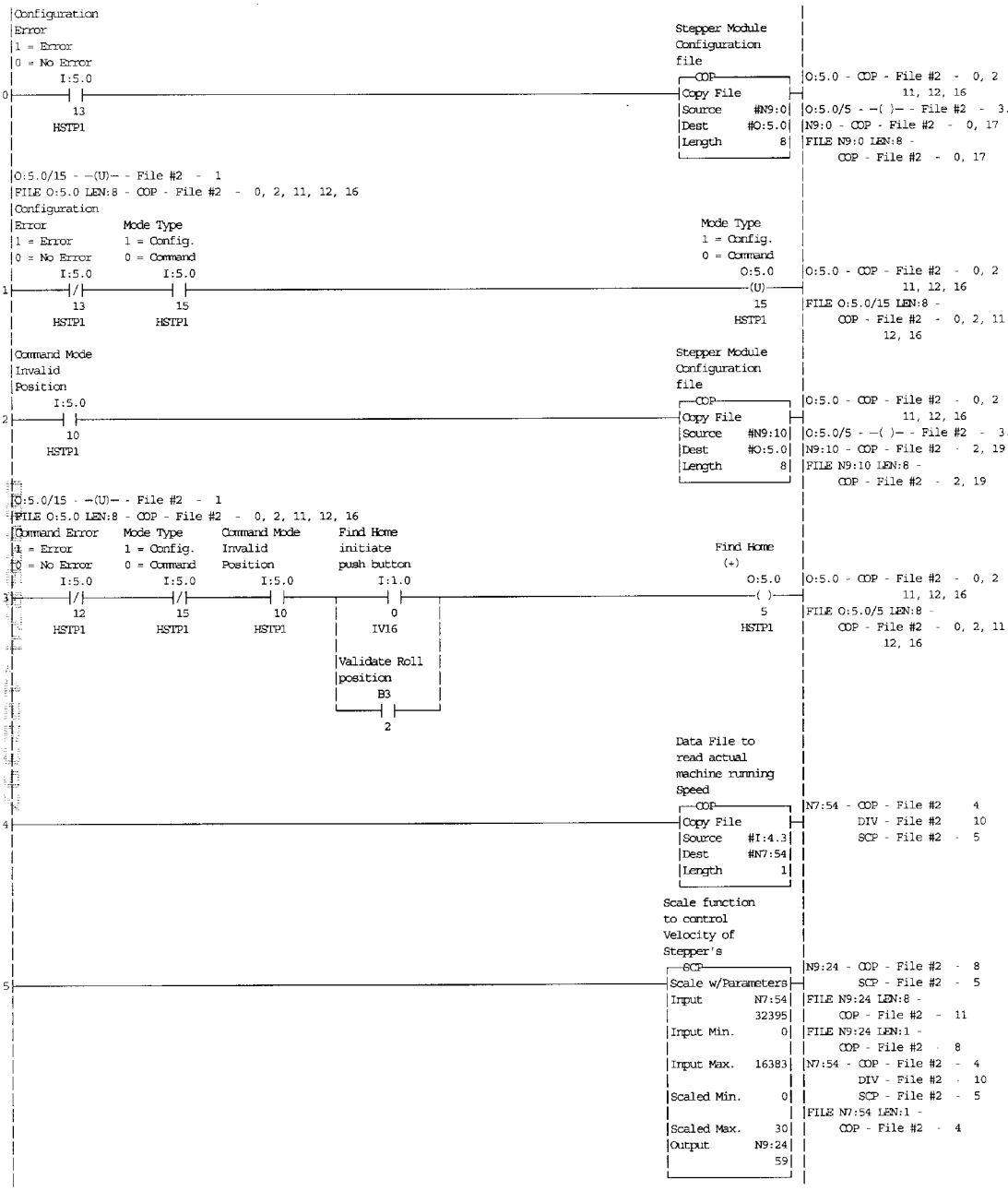
The present invention is preferably implemented by designing a seaming machine which has independently

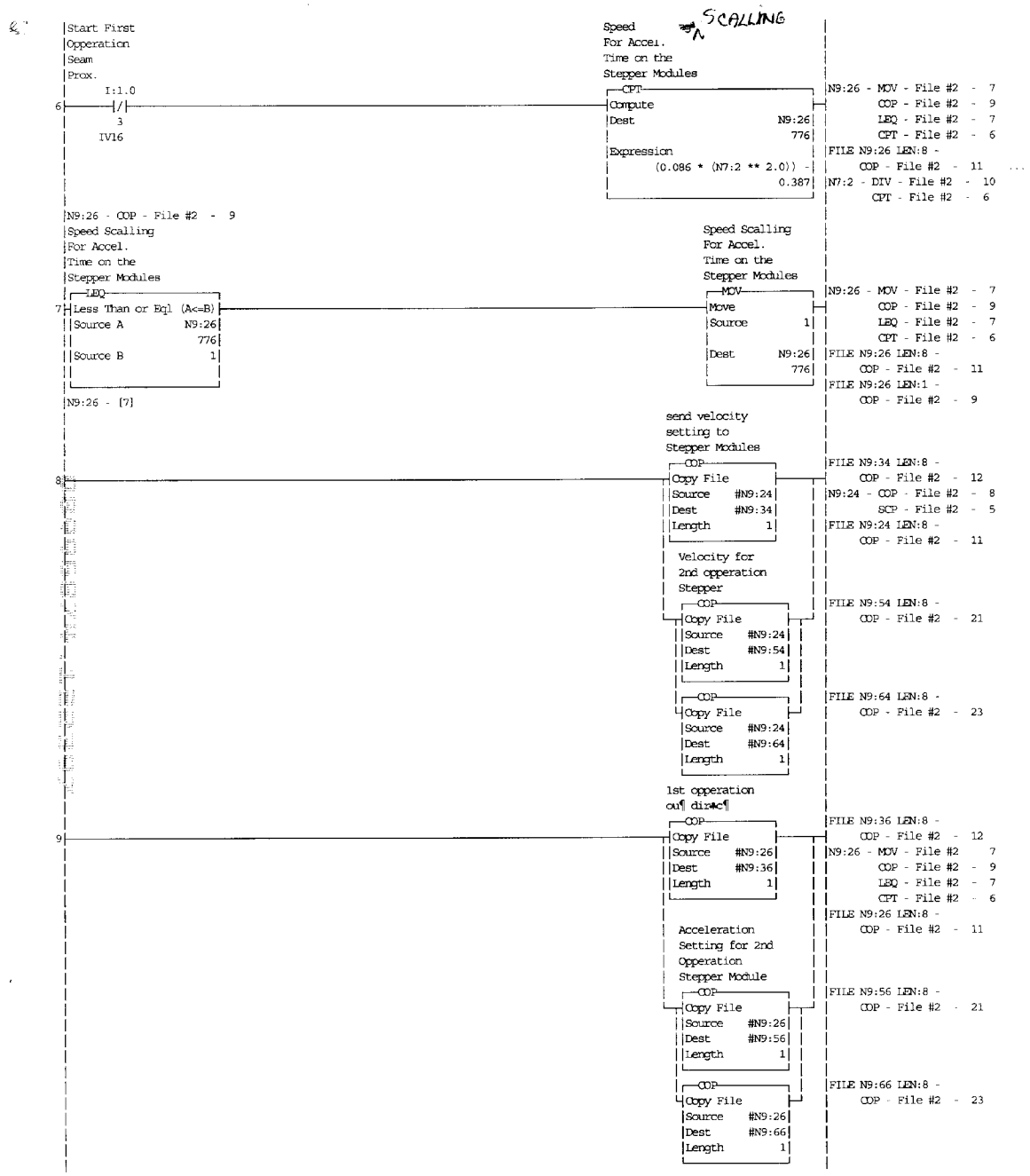
controlled drives for the seaming chuck and for the seaming rollers. However, the scope of the invention also includes conventional seaming machines (both vacuum and non-vacuum environment machines) which are retrofitted with independently controllable drives.

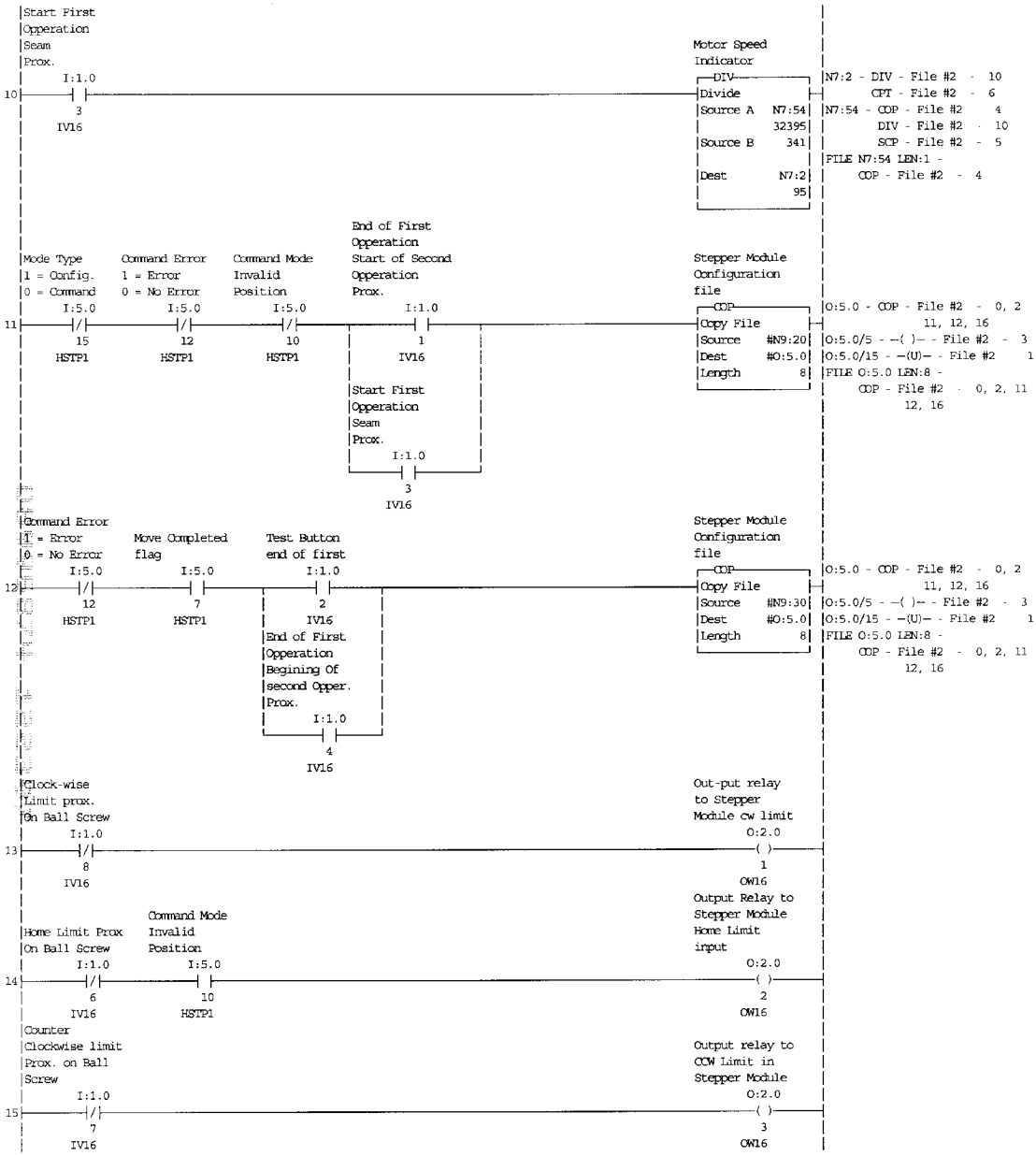
A conventional seaming machine has a single motor, but two power takeoffs, one for the drive which rotates the seaming roller with respect to the chuck, and one for the drive(s) which control the position of the seaming rollers with respect to a circumferential edge of the lid. In one suitable retrofit method, the drive which rotates the seaming roller with respect to the chuck becomes directly controlled by the programmable controller **54**, and new drives (which are also directly controlled by the programmable controller **54**) are installed to control the position of the seaming rollers with respect to a circumferential edge of the lid. Alternatively, a new drive is also installed to rotates the seaming roller with respect to the chuck. In addition, another drive (also directly controlled by the programmable controller **54**) is installed to control container body lifting, if precise control of the lifting process is desired.

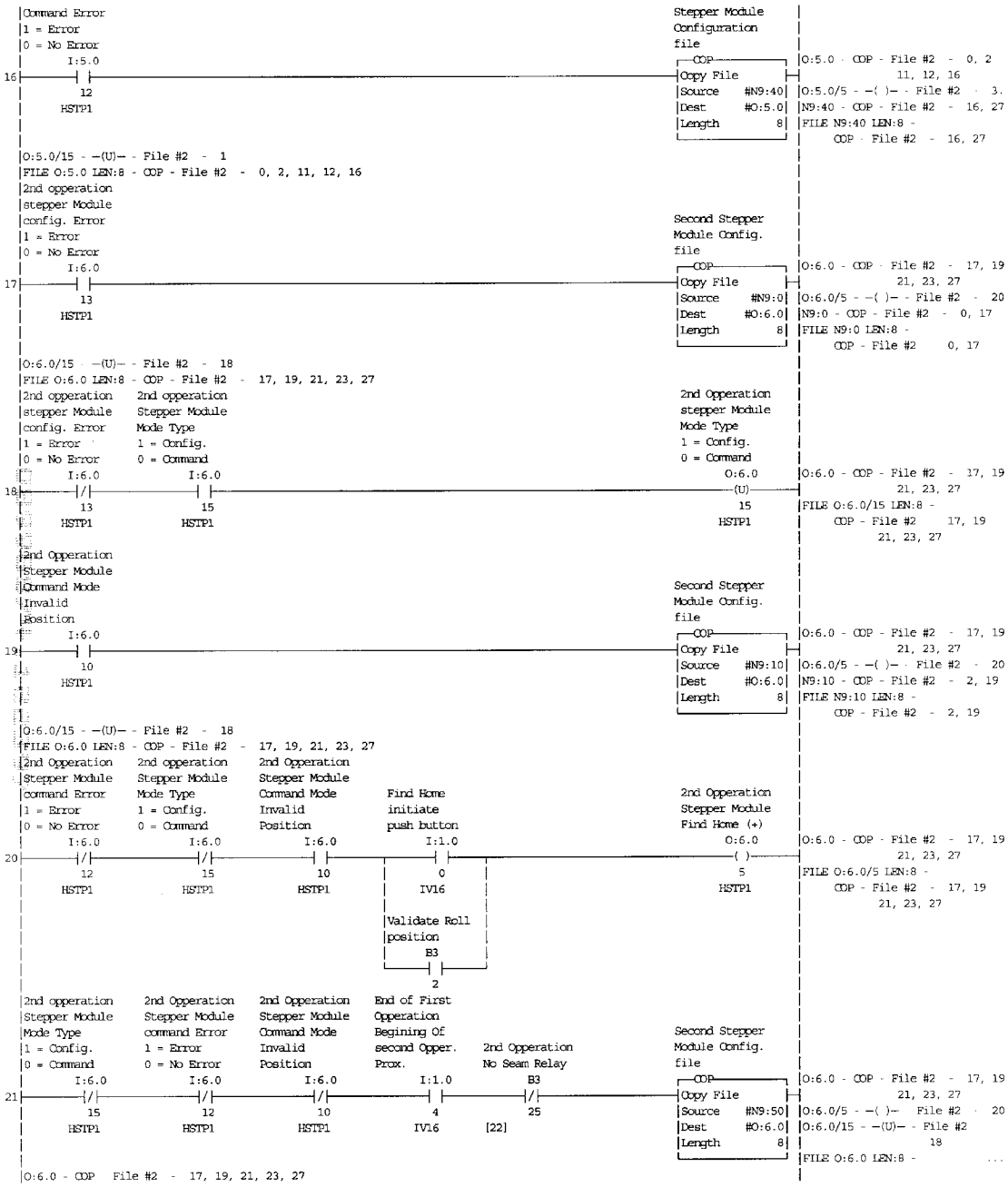
It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.

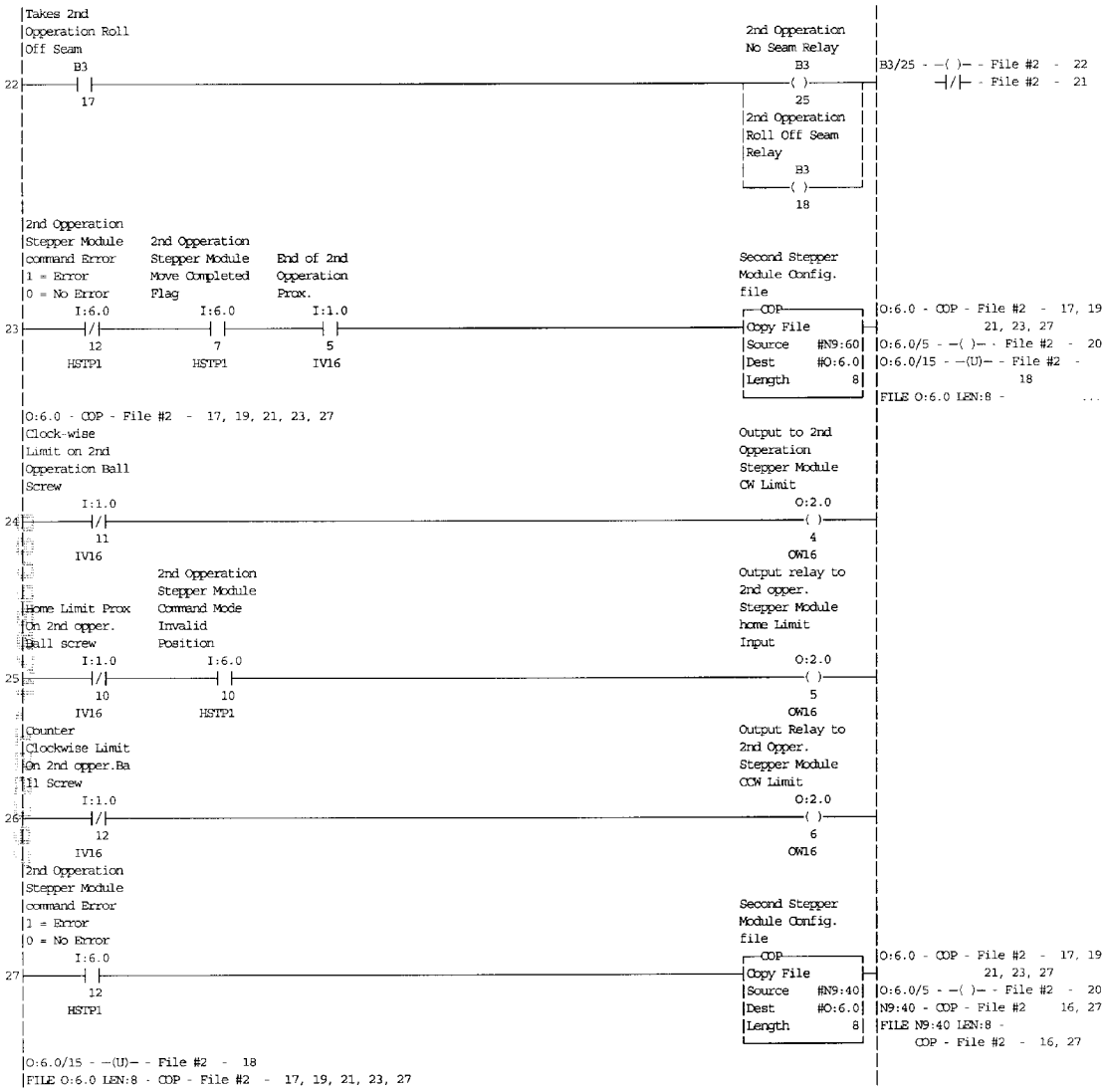
APPENDIX

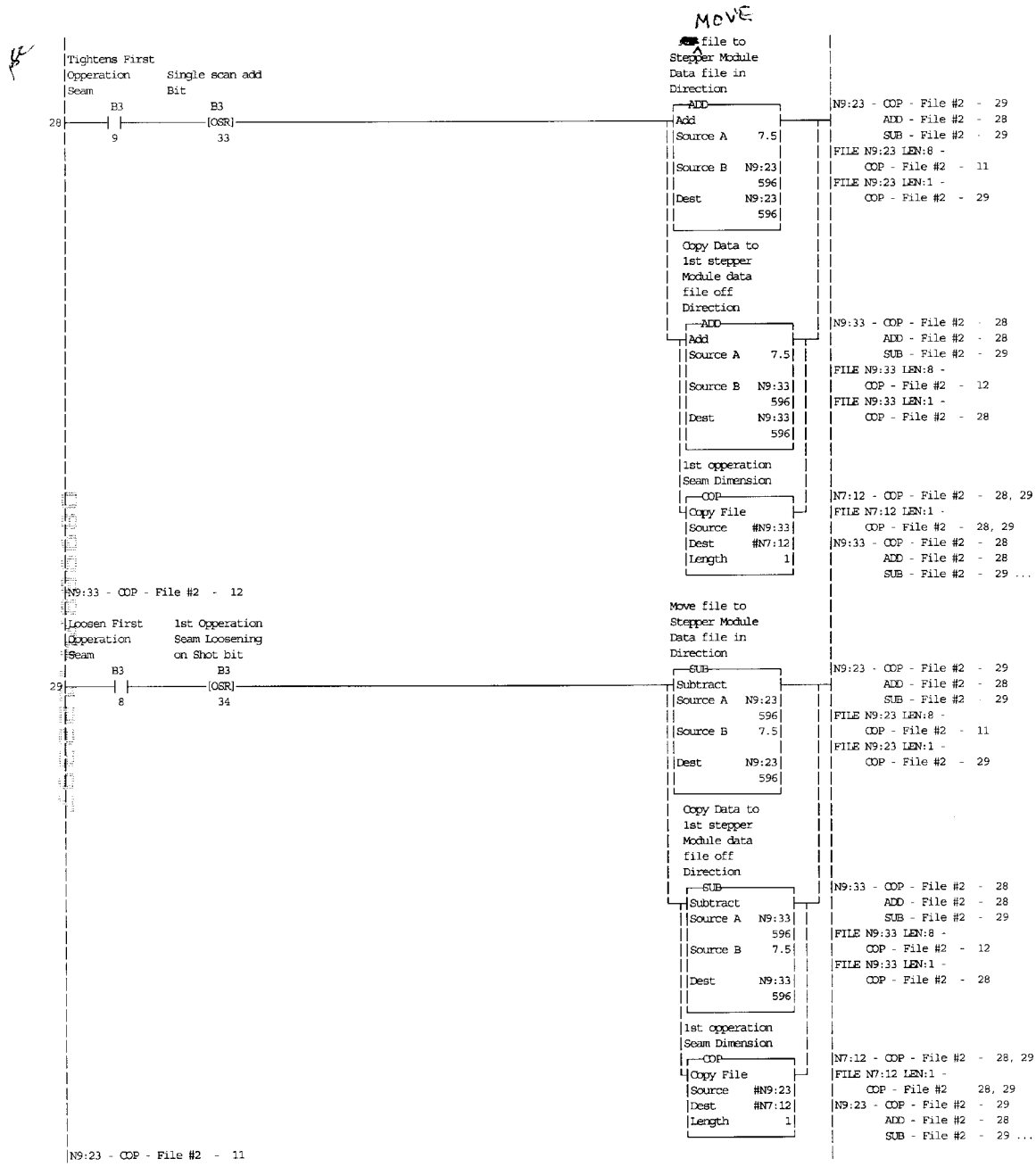

Configuration
Error
1 = Error
0 = No Error
I:5.0
13
HSTP1
Stepper Module
Configuration
file
COP
Copy File
Source #N9:0
Dest #O:5.0
Length 8
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
O:5.0/5 - -( )- - File #2 - 3.
N9:0 - COP - File #2 - 0, 17
FILE N9:0 LEN:8 -
COP - File #2 - 0, 17
O:5.0/15 - -(U)- - File #2 - 1
FILE O:5.0 LEN:8 - COP - File #2 - 0, 2, 11, 12, 16
Configuration
Error
1 = Error
0 = No Error
I:5.0
13
HSTP1
Mode Type
1 = Config.
0 = Command
I:5.0
15
HSTP1
Mode Type
1 = Config.
0 = Command
O:5.0
(U)
15
HSTP1
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
FILE O:5.0/15 LEN:8 -
COP - File #2 - 0, 2, 11
12, 16
Command Mode
Invalid
Position
I:5.0
10
HSTP1
Stepper Module
Configuration
file
COP
Copy File
Source #N9:10
Dest #O:5.0
Length 8
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
O:5.0/5 - -( )- - File #2 - 3.
N9:10 - COP - File #2 - 2, 19
FILE N9:10 LEN:8 -
COP - File #2 - 2, 19
O:5.0/15 - -(U)- - File #2 - 1
FILE O:5.0 LEN:8 - COP - File #2 - 0, 2, 11, 12, 16
Command Error
1 = Error
0 = No Error
I:5.0
12
HSTP1
Mode Type
1 = Config.
0 = Command
I:5.0
15
HSTP1
Command Mode
Invalid
Position
I:5.0
10
HSTP1
Find Home
initiate
push button
I:1.0
0
IV16
Validate Roll
position
B3
2
Find Home
(+)
O:5.0
( )
5
HSTP1
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
FILE O:5.0/5 LEN:8 -
COP - File #2 - 0, 2, 11
12, 16
Data File to
read actual
machine running
Speed
COP
Copy File
Source #I:4.3
Dest #N7:54
Length 1
N7:54 - COP - File #2 4
DIV - File #2 10
SCP - File #2 - 5
Scale function
to control
Velocity of
Stepper's
SCP
Scale w/Parameters
Input N7:54
32395
Input Min. 0
Input Max. 16383
Scaled Min. 0
Scaled Max. 30
Output N9:24
59
N9:24 - COP - File #2 - 8
SCP - File #2 - 5
FILE N9:24 LEN:8 -
COP - File #2 - 11
FILE N9:24 LEN:1 -
COP - File #2 - 8
N7:54 - COP - File #2 - 4
DIV - File #2 - 10
SCP - File #2 - 5
FILE N7:54 LEN:1 -
COP - File #2 - 4

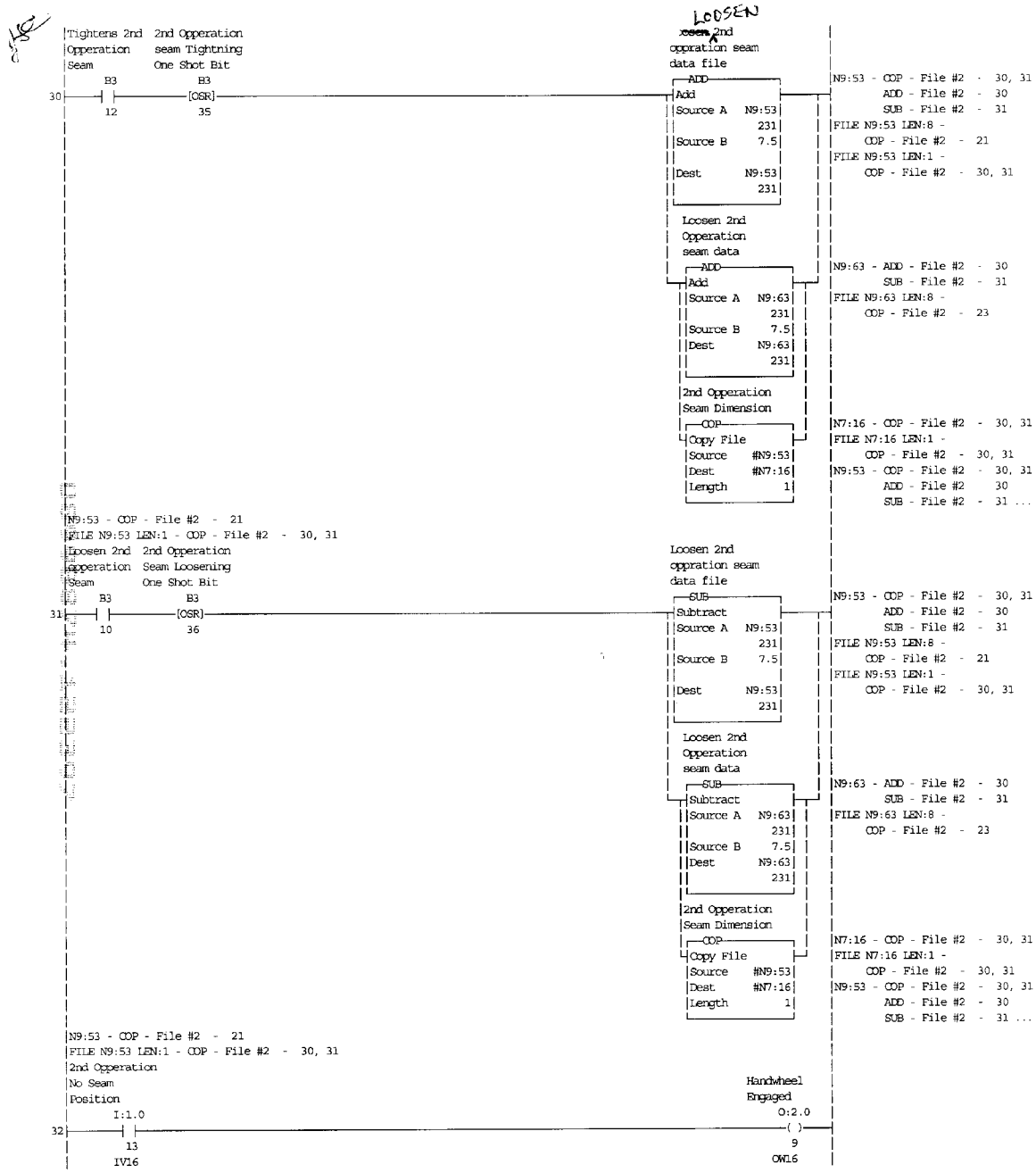

Start First
Opperation
Seam
Prox.
I:1.0
3
IV16
Speed
For Accel.
Time on the
Stepper Modules
SCALLING
CPT
Compute
Dest N9:26
776
Expression
(0.086 * (N7:2 ** 2.0)) -
0.387
N9:26 - MOV - File #2 - 7
COP - File #2 - 9
LEQ - File #2 - 7
CPT - File #2 - 6
FILE N9:26 LEN:8 -
COP - File #2 - 11
N7:2 - DIV - File #2 - 10
CPT - File #2 - 6
N9:26 - COP - File #2 - 9
Speed Scalling
For Accel.
Time on the
Stepper Modules
LEQ
Less Than or Eql (A<=B)
Source A N9:26
776
Source B 1
N9:26 - [7]
Speed Scalling
For Accel.
Time on the
Stepper Modules
MOV
Move
Source 1
Dest N9:26
776
N9:26 - MOV - File #2 - 7
COP - File #2 - 9
LEQ - File #2 - 7
CPT - File #2 - 6
FILE N9:26 LEN:8 -
COP - File #2 - 11
FILE N9:26 LEN:1 -
COP - File #2 - 9
send velocity
setting to
Stepper Modules
COP
Copy File
Source #N9:24
Dest #N9:34
Length 1
FILE N9:34 LEN:8 -
COP - File #2 - 12
N9:24 - COP - File #2 - 8
SCP - File #2 - 5
FILE N9:24 LEN:8 -
COP - File #2 - 11
Velocity for
2nd opperation
Stepper
COP
Copy File
Source #N9:24
Dest #N9:54
Length 1
FILE N9:54 LEN:8 -
COP - File #2 - 21
COP
Copy File
Source #N9:24
Dest #N9:64
Length 1
FILE N9:64 LEN:8 -
COP - File #2 - 23
1st opperation
out direct
COP
Copy File
Source #N9:26
Dest #N9:36
Length 1
FILE N9:36 LEN:8 -
COP - File #2 - 12
N9:26 - MOV - File #2 - 7
COP - File #2 - 9
LEQ - File #2 - 7
CPT - File #2 - 6
FILE N9:26 LEN:8 -
COP - File #2 - 11
Acceleration
Setting for 2nd
Opperation
Stepper Module
COP
Copy File
Source #N9:26
Dest #N9:56
Length 1
FILE N9:56 LEN:8 -
COP - File #2 - 21
COP
Copy File
Source #N9:26
Dest #N9:66
Length 1
FILE N9:66 LEN:8 -
COP - File #2 - 23

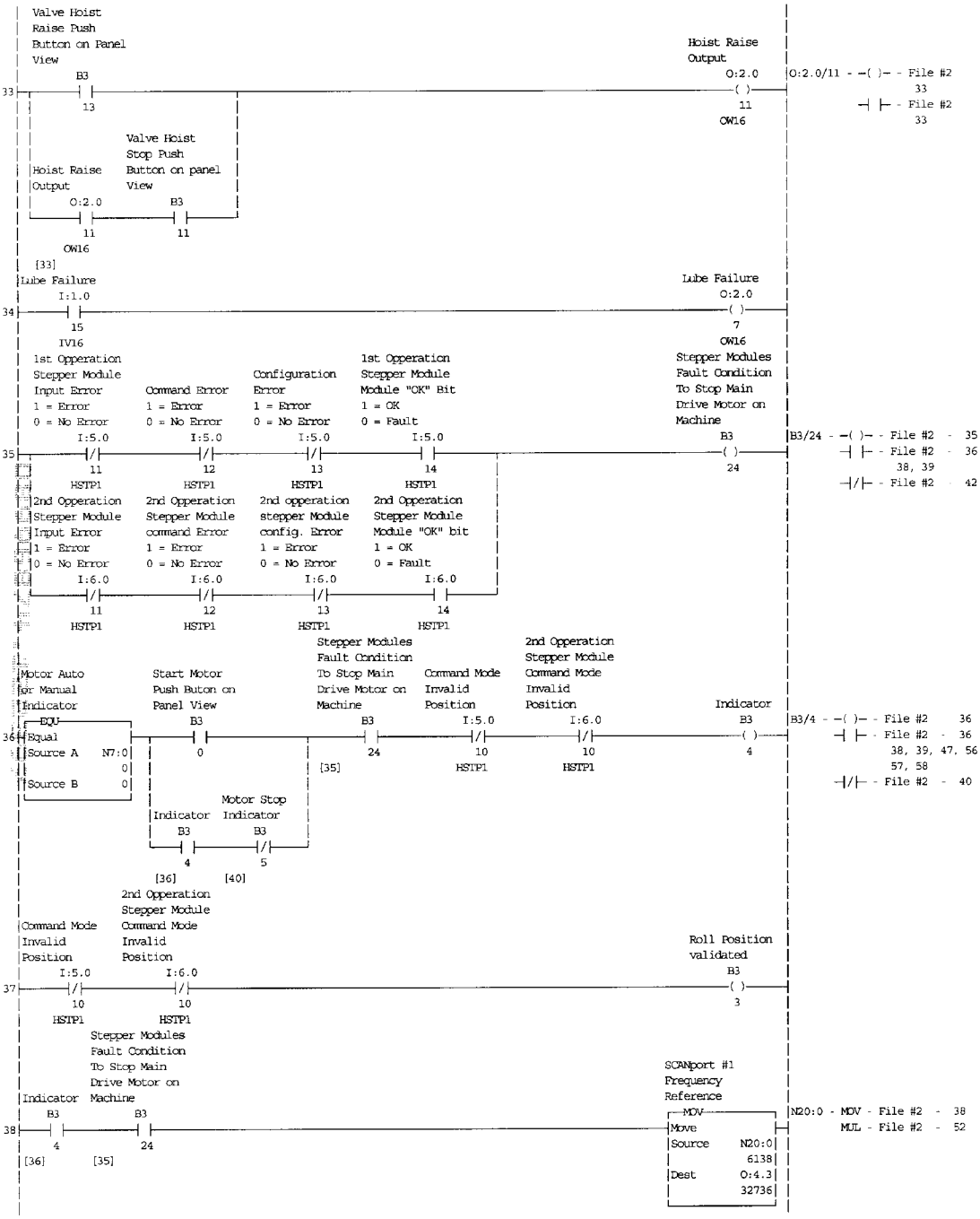

Start First Opperation Seam Prox.
I:1.0
3
IV16
Motor Speed Indicator
DIV
Divide
Source A N7:54
32395
Source B 341
Dest N7:2
95
N7:2 - DIV - File #2 - 10
CPT - File #2 - 6
N7:54 - COP - File #2 4
DIV - File #2 - 10
SCP - File #2 - 5
FILE N7:54 LEN:1 -
COP - File #2 - 4
Mode Type 1 = Config. 0 = Command
I:5.0
15
HSTP1
Command Error 1 = Error 0 = No Error
I:5.0
12
HSTP1
Command Mode Invalid Position
I:5.0
10
HSTP1
End of First Opperation Start of Second Opperation Prox.
I:1.0
1
IV16
Start First Opperation Seam Prox.
I:1.0
3
IV16
Stepper Module Configuration file
COP
Copy File
Source #N9:20
Dest #O:5.0
Length 8
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
O:5.0/5 - -( )- - File #2 - 3
O:5.0/15 - -(U)- - File #2 1
FILE O:5.0 LEN:8 -
COP - File #2 - 0, 2, 11
12, 16
Command Error 1 = Error 0 = No Error
I:5.0
12
HSTP1
Move Completed flag
I:5.0
7
HSTP1
Test Button end of first
I:1.0
2
IV16
End of First Opperation Begining Of second Opper. Prox.
I:1.0
4
IV16
Stepper Module Configuration file
COP
Copy File
Source #N9:30
Dest #O:5.0
Length 8
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
O:5.0/5 - -( )- - File #2 - 3
O:5.0/15 - -(U)- - File #2 1
FILE O:5.0 LEN:8 -
COP - File #2 - 0, 2, 11
12, 16
Clock-wise Limit prox. On Ball Screw
I:1.0
8
IV16
Out-put relay to Stepper Module cw limit
O:2.0
1
OW16
Home Limit Prox On Ball Screw
I:1.0
6
IV16
Command Mode Invalid Position
I:5.0
10
HSTP1
Output Relay to Stepper Module Home Limit input
O:2.0
2
OW16
Counter Clockwise limit Prox. on Ball Screw
I:1.0
7
IV16
Output relay to CCW Limit in Stepper Module
O:2.0
3
OW16

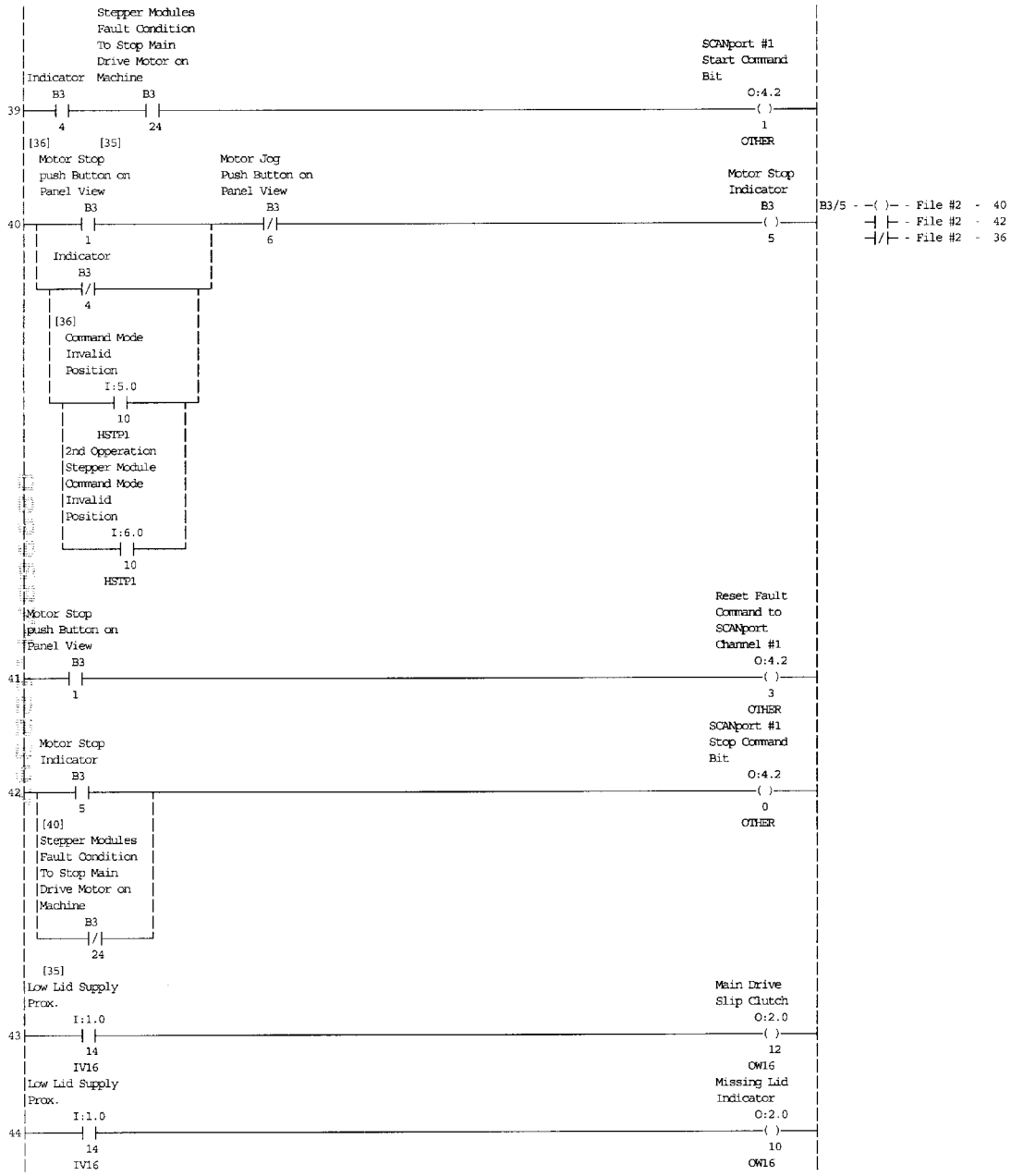

Command Error
1 = Error
0 = No Error
I:5.0
16
12
HSTP1
O:5.0/15 - -(U)- - File #2 - 1
FILE O:5.0 LEN:8 - COP - File #2 - 0, 2, 11, 12, 16
2nd opperation
stepper Module
config. Error
1 = Error
0 = No Error
I:6.0
17
13
HSTP1
O:6.0/15 - -(U)- - File #2 - 18
FILE O:6.0 LEN:8 - COP - File #2 - 17, 19, 21, 23, 27
2nd opperation
stepper Module
config. Error
1 = Error
0 = No Error
I:6.0
18
13
HSTP1
2nd opperation
Stepper Module
Mode Type
1 = Config.
0 = Command
I:6.0
15
HSTP1
2nd Opperation
Stepper Module
Command Mode
Invalid
Position
I:6.0
19
10
HSTP1
O:6.0/15 - -(U)- - File #2 - 18
FILE O:6.0 LEN:8 - COP - File #2 - 17, 19, 21, 23, 27
2nd Opperation
Stepper Module
command Error
1 = Error
0 = No Error
I:6.0
20
12
HSTP1
2nd opperation
Stepper Module
Mode Type
1 = Config.
0 = Command
I:6.0
15
HSTP1
2nd Opperation
Stepper Module
Command Mode
Invalid
Position
I:6.0
10
HSTP1
Find Home
initiate
push button
I:1.0
0
IV16
Validate Roll
position
B3
2
2nd opperation
Stepper Module
Mode Type
1 = Config.
0 = Command
I:6.0
21
15
HSTP1
2nd Opperation
Stepper Module
command Error
1 = Error
0 = No Error
I:6.0
12
HSTP1
2nd Opperation
Stepper Module
Command Mode
Invalid
Position
I:6.0
10
HSTP1
End of First
Opperation
Begining Of
second Opper.
Prox.
I:1.0
4
IV16
2nd Opperation
No Seam Relay
B3
25
[22]
O:6.0 - COP File #2 - 17, 19, 21, 23, 27
Stepper Module
Configuration
file
COP
Copy File
Source #N9:40
Dest #O:5.0
Length 8
Second Stepper
Module Config.
file
COP
Copy File
Source #N9:0
Dest #O:6.0
Length 8
2nd Opperation
stepper Module
Mode Type
1 = Config.
0 = Command
O:6.0
(U)
15
HSTP1
Second Stepper
Module Config.
file
COP
Copy File
Source #N9:10
Dest #O:6.0
Length 8
2nd Opperation
Stepper Module
Find Home (+)
O:6.0
( )
5
HSTP1
Second Stepper
Module Config.
file
COP
Copy File
Source #N9:50
Dest #O:6.0
Length 8
O:5.0 - COP - File #2 - 0, 2
11, 12, 16
O:5.0/5 - -( )- - File #2 - 3.
N9:40 - COP - File #2 - 16, 27
FILE N9:40 LEN:8 -
COP - File #2 - 16, 27
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
O:6.0/5 - -( )- - File #2 - 20
N9:0 - COP - File #2 - 0, 17
FILE N9:0 LEN:8 -
COP - File #2 0, 17
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
FILE O:6.0/15 LEN:8 -
COP - File #2 17, 19
21, 23, 27
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
O:6.0/5 - -( )- - File #2 - 20
N9:10 - COP - File #2 - 2, 19
FILE N9:10 LEN:8 -
COP - File #2 - 2, 19
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
FILE O:6.0/5 LEN:8 -
COP - File #2 - 17, 19
21, 23, 27
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
O:6.0/5 - -( )- File #2 - 20
O:6.0/15 - -(U)- - File #2
18
FILE O:6.0 LEN:8 -

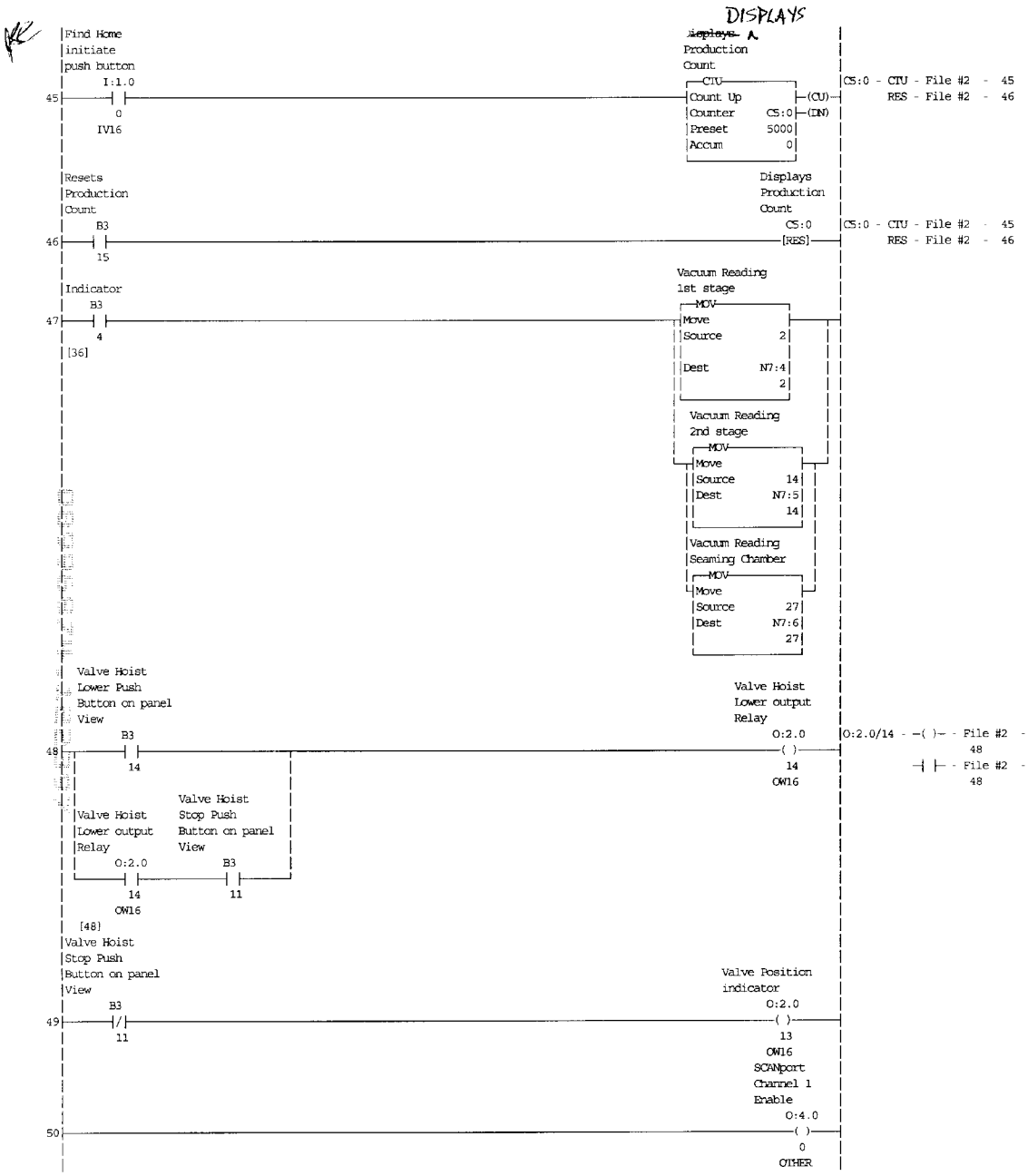

Takes 2nd
Opperation Roll
Off Seam
B3
17
2nd Opperation
No Seam Relay
B3
25
B3/25 - —( )— - File #2 - 22
—/|— - File #2 - 21
2nd Opperation
Roll Off Seam
Relay
B3
18
2nd Opperation
Stepper Module
command Error
1 = Error
0 = No Error
I:6.0
12
HSTP1
2nd Opperation
Stepper Module
Move Completed
Flag
I:6.0
7
HSTP1
End of 2nd
Opperation
Prox.
I:1.0
5
IV16
Second Stepper
Module Config.
file
COP
Copy File
Source #N9:60
Dest #O:6.0
Length 8
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
O:6.0/5 - —( )— - File #2 - 20
O:6.0/15 - —(U)— - File #2 -
18
FILE O:6.0 LEN:8 -
O:6.0 - COP - File #2 - 17, 19, 21, 23, 27
Clock-wise
Limit on 2nd
Opperation Ball
Screw
I:1.0
11
IV16
Output to 2nd
Opperation
Stepper Module
CW Limit
O:2.0
4
OW16
Home Limit Prox
On 2nd opper.
Ball screw
I:1.0
10
IV16
2nd Opperation
Stepper Module
Command Mode
Invalid
Position
I:6.0
10
HSTP1
Output relay to
2nd opper.
Stepper Module
home Limit
Input
O:2.0
5
OW16
Counter
Clockwise Limit
On 2nd opper.Ba
ll Screw
I:1.0
12
IV16
Output Relay to
2nd Opper.
Stepper Module
CCW Limit
O:2.0
6
OW16
2nd Opperation
Stepper Module
command Error
1 = Error
0 = No Error
I:6.0
12
HSTP1
Second Stepper
Module Config.
file
COP
Copy File
Source #N9:40
Dest #O:6.0
Length 8
O:6.0 - COP - File #2 - 17, 19
21, 23, 27
O:6.0/5 - —( )— - File #2 - 20
N9:40 - COP - File #2 16, 27
FILE N9:40 LEN:8 -
COP - File #2 - 16, 27
O:6.0/15 - —(U)— - File #2 - 18
FILE O:6.0 LEN:8 - COP - File #2 - 17, 19, 21, 23, 27

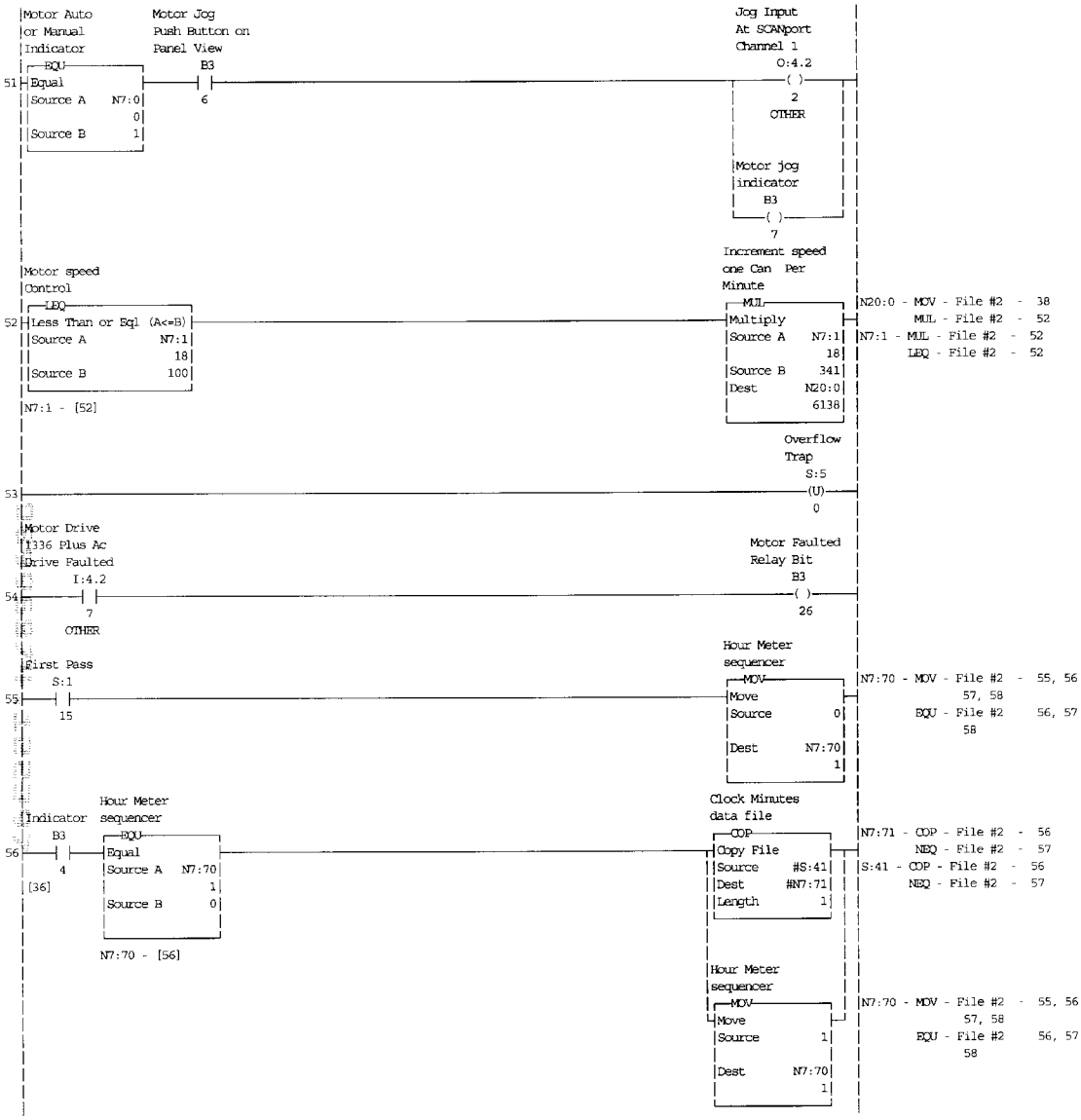

MOVE
Tightens First Opperation Seam
Single scan add Bit
B3 9
B3 OSR 33
28
file to Stepper Module Data file in Direction
ADD
Add
Source A 7.5
Source B N9:23 596
Dest N9:23 596
N9:23 - COP - File #2 - 29
ADD - File #2 - 28
SUB - File #2 - 29
FILE N9:23 LEN:8 -
COP - File #2 - 11
FILE N9:23 LEN:1 -
COP - File #2 - 29
Copy Data to 1st stepper Module data file off Direction
ADD
Add
Source A 7.5
Source B N9:33 596
Dest N9:33 596
N9:33 - COP - File #2 - 28
ADD - File #2 - 28
SUB - File #2 - 29
FILE N9:33 LEN:8 -
COP - File #2 - 12
FILE N9:33 LEN:1 -
COP - File #2 - 28
1st opperation Seam Dimension
COP
Copy File
Source #N9:33
Dest #N7:12
Length 1
N7:12 - COP - File #2 - 28, 29
FILE N7:12 LEN:1 -
COP - File #2 - 28, 29
N9:33 - COP - File #2 - 28
ADD - File #2 - 28
SUB - File #2 - 29 ...
N9:33 - COP - File #2 - 12
Loosen First Opperation Seam
1st Opperation Seam Loosening on Shot bit
B3 8
B3 OSR 34
29
Move file to Stepper Module Data file in Direction
SUB
Subtract
Source A N9:23 596
Source B 7.5
Dest N9:23 596
N9:23 - COP - File #2 - 29
ADD - File #2 - 28
SUB - File #2 - 29
FILE N9:23 LEN:8 -
COP - File #2 - 11
FILE N9:23 LEN:1 -
COP - File #2 - 29
Copy Data to 1st stepper Module data file off Direction
SUB
Subtract
Source A N9:33 596
Source B 7.5
Dest N9:33 596
N9:33 - COP - File #2 - 28
ADD - File #2 - 28
SUB - File #2 - 29
FILE N9:33 LEN:8 -
COP - File #2 - 12
FILE N9:33 LEN:1 -
COP - File #2 - 28
1st opperation Seam Dimension
COP
Copy File
Source #N9:23
Dest #N7:12
Length 1
N7:12 - COP - File #2 - 28, 29
FILE N7:12 LEN:1 -
COP - File #2 28, 29
N9:23 - COP - File #2 - 29
ADD - File #2 - 28
SUB - File #2 - 29 ...
N9:23 - COP - File #2 - 11

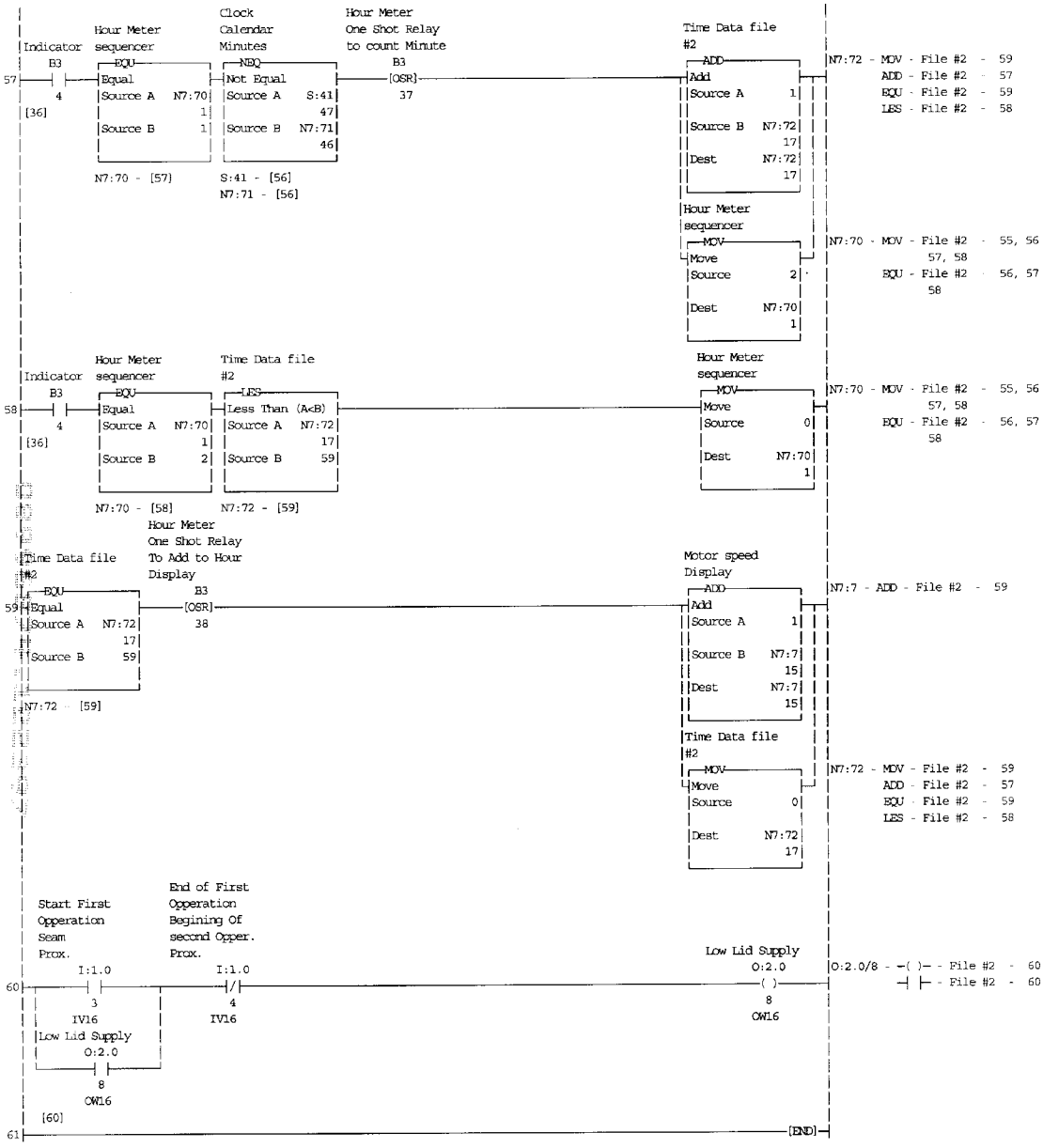

Tightens 2nd Opperation Seam
B3 12
B3 35
[OSR]
2nd Opperation seam Tightning One Shot Bit
30
LOOSEN
2nd opperation seam data file
ADD
Add
Source A N9:53 231
Source B 7.5
Dest N9:53 231
Loosen 2nd Opperation seam data
ADD
Add
Source A N9:63 231
Source B 7.5
Dest N9:63 231
2nd Opperation Seam Dimension
COP
Copy File
Source #N9:53
Dest #N7:16
Length 1
N9:53 - COP - File #2 - 21
FILE N9:53 LEN:1 - COP - File #2 - 30, 31
N9:53 - COP - File #2 - 30, 31
ADD - File #2 - 30
SUB - File #2 - 31
FILE N9:53 LEN:8 -
COP - File #2 - 21
FILE N9:53 LEN:1 -
COP - File #2 - 30, 31
N9:63 - ADD - File #2 - 30
SUB - File #2 - 31
FILE N9:63 LEN:8 -
COP - File #2 - 23
N7:16 - COP - File #2 - 30, 31
FILE N7:16 LEN:1 -
COP - File #2 - 30, 31
N9:53 - COP - File #2 - 30, 31
ADD - File #2 - 30
SUB - File #2 - 31 ...
N9:53 - COP - File #2 - 21
FILE N9:53 LEN:1 - COP - File #2 - 30, 31
Loosen 2nd Opperation Seam
B3 10
B3 36
[OSR]
Loosen 2nd Opperation Seam Loosening One Shot Bit
31
Loosen 2nd opperation seam data file
SUB
Subtract
Source A N9:53 231
Source B 7.5
Dest N9:53 231
Loosen 2nd Opperation seam data
SUB
Subtract
Source A N9:63 231
Source B 7.5
Dest N9:63 231
2nd Opperation Seam Dimension
COP
Copy File
Source #N9:53
Dest #N7:16
Length 1
N9:53 - COP - File #2 - 21
FILE N9:53 LEN:1 - COP - File #2 - 30, 31
N9:53 - COP - File #2 - 30, 31
ADD - File #2 - 30
SUB - File #2 - 31
FILE N9:53 LEN:8 -
COP - File #2 - 21
FILE N9:53 LEN:1 -
COP - File #2 - 30, 31
N9:63 - ADD - File #2 - 30
SUB - File #2 - 31
FILE N9:63 LEN:8 -
COP - File #2 - 23
N7:16 - COP - File #2 - 30, 31
FILE N7:16 LEN:1 -
COP - File #2 - 30, 31
N9:53 - COP - File #2 - 30, 31
ADD - File #2 - 30
SUB - File #2 - 31 ...
N9:53 - COP - File #2 - 21
FILE N9:53 LEN:1 - COP - File #2 - 30, 31
2nd Opperation No Seam Position
I:1.0 13
IV16
Handwheel Engaged
O:2.0 9
OWL6
( )
32


Valve Hoist Raise Push Button on Panel View
B3 13
Hoist Raise Output O:2.0 11 OW16
Valve Hoist Stop Push Button on panel View
B3 11
[33]
Lube Failure I:1.0 15 IV16
Lube Failure O:2.0 7 OW16
1st Opperation Stepper Module Input Error 1 = Error 0 = No Error I:5.0 11 HSTP1
Command Error 1 = Error 0 = No Error I:5.0 12 HSTP1
Configuration Error 1 = Error 0 = No Error I:5.0 13 HSTP1
1st Opperation Stepper Module "OK" Bit 1 = OK 0 = Fault I:5.0 14 HSTP1
Stepper Modules Fault Condition To Stop Main Drive Motor on Machine B3 24
2nd Opperation Stepper Module Input Error 1 = Error 0 = No Error I:6.0 11 HSTP1
2nd Opperation Stepper Module command Error 1 = Error 0 = No Error I:6.0 12 HSTP1
2nd opperation stepper Module config. Error 1 = Error 0 = No Error I:6.0 13 HSTP1
2nd Opperation Stepper Module Module "OK" bit 1 = OK 0 = Fault I:6.0 14 HSTP1
Motor Auto for Manual Indicator
EQU Equal Source A N7:0 0 Source B 0
Start Motor Push Buton on Panel View B3 0
Stepper Modules Fault Condition To Stop Main Drive Motor on Machine B3 24 [35]
Command Mode Invalid Position I:5.0 10 HSTP1
2nd Opperation Stepper Module Command Mode Invalid Position I:6.0 10 HSTP1
Indicator B3 4
Motor Stop Indicator B3 5
[36] [40]
Indicator B3 4 [36]
Command Mode Invalid Position I:5.0 10 HSTP1
2nd Opperation Stepper Module Command Mode Invalid Position I:6.0 10 HSTP1
Stepper Modules Fault Condition To Stop Main Drive Motor on Machine B3 24 [35]
Roll Position validated B3 3
SCANport #1 Frequency Reference
MOV Move Source N20:0 6138 Dest O:4.3 32736
O:2.0/11 - -( )- - File #2 33
- File #2 33
B3/24 - -( )- - File #2 - 35
- File #2 - 36
38, 39
- File #2 - 42
Indicator B3 4
B3/4 - -( )- - File #2 36
- File #2 - 36
38, 39, 47, 56
57, 58
- File #2 - 40
N20:0 - MOV - File #2 - 38
MUL - File #2 - 52


Stepper Modules
Fault Condition
To Stop Main
Drive Motor on
Indicator Machine
B3
4
B3
24
SCANport #1
Start Command
Bit
O:4.2
1
OTHER
39
[36]
Motor Stop
push Button on
Panel View
B3
1
[35]
Motor Jog
Push Button on
Panel View
B3
6
Motor Stop
Indicator
B3
5
B3/5 - -( )- - File #2 - 40
File #2 - 42
File #2 - 36
40
Indicator
B3
4
[36]
Command Mode
Invalid
Position
I:5.0
10
HSTP1
2nd Opperation
Stepper Module
Command Mode
Invalid
Position
I:6.0
10
HSTP1
Motor Stop
push Button on
Panel View
B3
1
Reset Fault
Command to
SCANport
Channel #1
O:4.2
3
OTHER
41
Motor Stop
Indicator
B3
5
SCANport #1
Stop Command
Bit
O:4.2
0
OTHER
42
[40]
Stepper Modules
Fault Condition
To Stop Main
Drive Motor on
Machine
B3
24
[35]
Low Lid Supply
Prox.
I:1.0
14
IV16
Main Drive
Slip Clutch
O:2.0
12
OW16
43
Low Lid Supply
Prox.
I:1.0
14
IV16
Missing Lid
Indicator
O:2.0
10
OW16
44


DISPLAYS
Find Home initiate push button
I:1.0
0
IV16
45
Displays Production Count
CTU
Count Up
Counter C5:0
Preset 5000
Accum 0
(CU)
(DN)
C5:0 - CTU - File #2 - 45
RES - File #2 - 46
Resets Production Count
B3
15
46
Displays Production Count
C5:0
[RES]
C5:0 - CTU - File #2 - 45
RES - File #2 - 46
Indicator
B3
4
[36]
47
Vacuum Reading 1st stage
MOV
Move
Source 2
Dest N7:4
2
Vacuum Reading 2nd stage
MOV
Move
Source 14
Dest N7:5
14
Vacuum Reading Seaming Chamber
MOV
Move
Source 27
Dest N7:6
27
Valve Hoist Lower Push Button on panel View
B3
14
48
Valve Hoist Lower output Relay
O:2.0
14
OW16
O:2.0/14 - -( )- - File #2 - 48
- File #2 - 48
Valve Hoist Lower output Relay
O:2.0
14
OW16
Valve Hoist Stop Push Button on panel View
B3
11
[48]
Valve Hoist Stop Push Button on panel View
B3
11
49
Valve Position indicator
O:2.0
13
OW16
SCANport Channel 1 Enable
O:4.0
0
OTHER
50


Motor Auto or Manual Indicator
EQU
Equal
Source A N7:0
0
Source B 1
Motor Jog Push Button on Panel View
B3
6
Jog Input At SCANport Channel 1
O:4.2
2
OTHER
Motor jog indicator
B3
7
Motor speed Control
LEQ
Less Than or Eql (A<=B)
Source A N7:1
18
Source B 100
N7:1 - [52]
Increment speed one Can Per Minute
MUL
Multiply
Source A N7:1
18
Source B 341
Dest N20:0
6138
N20:0 - MOV - File #2 - 38
MUL - File #2 - 52
N7:1 - MUL - File #2 - 52
LEQ - File #2 - 52
Overflow Trap
S:5
(U)
0
Motor Drive 1336 Plus Ac Drive Faulted
I:4.2
7
OTHER
Motor Faulted Relay Bit
B3
26
First Pass
S:1
15
Hour Meter sequencer
MOV
Move
Source 0
Dest N7:70
1
N7:70 - MOV - File #2 - 55, 56
57, 58
EQU - File #2 56, 57
58
Indicator
B3
4
[36]
Hour Meter sequencer
EQU
Equal
Source A N7:70
1
Source B 0
N7:70 - [56]
Clock Minutes data file
COP
Copy File
Source #S:41
Dest #N7:71
Length 1
N7:71 - COP - File #2 - 56
NEQ - File #2 - 57
S:41 - COP - File #2 - 56
NEQ - File #2 - 57
Hour Meter sequencer
MOV
Move
Source 1
Dest N7:70
1
N7:70 - MOV - File #2 - 55, 56
57, 58
EQU - File #2 56, 57
58


Indicator
B3
4
[36]
Hour Meter sequencer
EQU
Equal
Source A N7:70 1
Source B 1
N7:70 - [57]
Clock Calendar Minutes
NEQ
Not Equal
Source A S:41 47
Source B N7:71 46
S:41 - [56]
N7:71 - [56]
Hour Meter One Shot Relay to count Minute
B3
[OSR]
37
Time Data file #2
ADD
Add
Source A 1
Source B N7:72 17
Dest N7:72 17
N7:72 - MOV - File #2 - 59
ADD - File #2 - 57
EQU - File #2 - 59
LES - File #2 - 58
Hour Meter sequencer
MOV
Move
Source 2
Dest N7:70 1
N7:70 - MOV - File #2 - 55, 56 57, 58
EQU - File #2 - 56, 57 58
Indicator
B3
4
[36]
Hour Meter sequencer
EQU
Equal
Source A N7:70 1
Source B 2
N7:70 - [58]
Time Data file #2
LES
Less Than (A<B)
Source A N7:72 17
Source B 59
N7:72 - [59]
Hour Meter sequencer
MOV
Move
Source 0
Dest N7:70 1
N7:70 - MOV - File #2 - 55, 56 57, 58
EQU - File #2 - 56, 57 58
Time Data file #2
EQU
Equal
Source A N7:72 17
Source B 59
N7:72 - [59]
Hour Meter One Shot Relay To Add to Hour Display
B3
[OSR]
38
Motor speed Display
ADD
Add
Source A 1
Source B N7:7 15
Dest N7:7 15
N7:7 - ADD - File #2 - 59
Time Data file #2
MOV
Move
Source 0
Dest N7:72 17
N7:72 - MOV - File #2 - 59
ADD - File #2 - 57
EQU - File #2 - 59
LES - File #2 - 58
Start First Opperation Seam Prox.
I:1.0
3
IV16
Low Lid Supply
O:2.0
8
OW16
[60]
End of First Opperation Begining Of second Opper. Prox.
I:1.0
4
IV16
Low Lid Supply
O:2.0
8
OW16
O:2.0/8 - File #2 - 60
File #2 - 60
[END]

I claim:

1. A container seaming machine comprising:

(a) a seaming chuck for holding a lid firmly against an end of a container body during a seaming operation;

(b) a first seaming roller;

(c) a first drive connected to the first seaming roller for positioning the first seaming roller with respect to a circumferential edge of the lid; and

(d) a second drive for causing rotation of the first seaming roller with respect to the chuck, container body and container lid, the first drive and the second drive being independently controllable from each other.

2. A machine according to claim 1 wherein the first drive adjustably positions the first seaming roller toward and away from a center axis of the container body, thereby positioning the first seaming roller with respect to the circumferential edge of the lid.

3. A machine according to claim 2 further comprising:

(e) a controller for independently controlling the first and the second drive so that the position of the first seaming roller with respect to the circumferential edge of the lid and the position of the first seaming roller with respect to the container body and container lid during the rotation are coordinated to perform a seaming operation.

4. A machine according to claim 3 wherein the controller is programmable to output a set of instructions for a specified container body diameter, the instruction including position instructions for the first drive and rotation instructions for the second drive.

5. A machine according to claim 4 wherein the controller includes an input for receiving data regarding the diameter of container bodies to be seamed, the position instructions for the first drive being adjustable based on the diameter data.

6. A machine according to claim 5 wherein the position instructions for the first drive are adjustable while the machine is in operation, thereby causing a new set of position instructions to be output from the controller without having to stop the machine.

7. A machine according to claim 5 wherein the input is an operator input device associated with the controller.

8. A machine according to claim 5 wherein the input is adapted to receive the diameter from an automated measuring device.

9. A machine according to claim 4 wherein the controller includes an input for receiving feedback data regarding seamed containers, the position instructions for the first drive being adjustable based on the feedback data.

10. A machine according to claim 9 wherein the position instructions for the first drive resulting from the feedback data are adjustable while the machine is in operation, thereby causing a new set of position instructions to be output from the controller without having to stop the machine.

11. A machine according to claim 3 wherein the controller is programmable to output a plurality of different sets of instructions, each set of instructions relating to a specified container body size and including position instructions for the first drive and rotation instructions for the second drive.

12. A machine according to claim 11 wherein the controller has an input for allowing the container size to be changed while the machine is in operation, thereby causing an new set of instructions to be output without having to stop the machine.

13. A machine according to claim 3 wherein the controller is a programmable controller for independently controlling the first and second drives based upon a stored program.

14. A machine according to claim 3 wherein the controller controls the first drive to intermittently engage and disengage the first seaming roller from a seaming position during rotation of the first seaming roller with respect to the chuck, container body and container lid, thereby allowing the machine to perform spot clinching on the container body.

15. A machine according to claim 1 further comprising:

(e) a third drive for adjusting the relative vertical position of the container end with respect to the first seaming roller so that the machine may accommodate container bodies of different heights.

16. A machine according to claim 15 further comprising a controller for outputting position instructions for the third drive.

17. A machine according to claim 16 wherein the controller has an input for receiving height data regarding container bodies to be seamed, the controller using the height data to output the position instructions for the third drive.

18. A machine according to claim 17 wherein the height data is received from an automated container body height measuring device.

19. A machine according to claim 17 wherein the height data is received from an operator input device associated with the controller.

20. A machine according to claim 17 wherein the position instructions for the third drive are adjustable while the machine is in operation, thereby causing a new set of position instructions for the third drive to be output from the controller without having to stop the machine.

21. A machine according to claim 15 wherein the container body has another end, the machine further comprising a base surface for placing the other end of the container body thereon, the third drive causing the base surface to move toward the seaming chuck so that the end of the container body and the lid are held firmly against the seaming chuck.

22. A machine according to claim 15 wherein the third drive includes:

(i) a servomotor for receiving control data related to the desired vertical position of the container end with respect to the first seaming roller, the servomotor having an output; and

(ii) a linear actuator for translating the servomotor output to cause the appropriate vertical movement of the container end with respect to the first seaming roller prior to a seaming operation.

23. A machine according to claim 1 wherein the first drive includes:

(i) a servomotor for receiving control data related to the desired position of the first seaming roller with respect to the circumferential edge of the container body, and the container lid, the servomotor having an output;

(ii) a linear actuator for translating the servomotor output to cause movement of the first seaming roller.

24. A machine according to claim 23 wherein the servomotor is a stepper motor.

25. A machine according to claim 23 wherein the linear actuator is a ball screw mechanism.

26. A machine according to claim 23 wherein the linear actuator is a pneumatic cylinder.

27. A machine according to claim 1 further comprising:

(e) a second seaming roller;

(f) a third drive connected to the second seaming roller for positioning the second seaming roller with respect to the circumferential edge of the lid, wherein the third drive is independently controllable from the first and the second drives.

28. A machine according to claim 27 wherein the first seaming roller begins to roll the lid and the container body, and the second seaming roller completes the seam, the first drive and the third drive being coordinated to position the first and second rollers with respect to the circumferential edge of the lid to cause the first and second seaming rollers to form a double seam.

29. A machine according to claim 1 wherein the first and second drives are independently controllable while the machine is in operation.

30. A machine according to claim 1 wherein the second drive causes rotation of the seaming chuck, thereby causing rotation of the container body and container lid.

31. A machine according to claim 1 further comprising:

(e) a programmable controller for independently controlling the first and the second drive so that the position of the first seaming roller with respect to the circumferential edge of the lid and the position of the first seaming roller with respect to the container body and container lid during the rotation are coordinated to perform a seaming operation.

32. A machine according to claim 1 further comprising:

(e) a programmable controller for independently controlling the first and second drive so that the drives are coordinated to perform a seaming operation.

33. A machine according to claim 1 wherein the first drive includes a linear actuator for causing movement of the first seaming roller.

34. A container seaming machine comprising:

(a) a seaming chuck for holding a lid firmly against an end of a container body during a seaming operation;

(b) a first drive for causing rotation of the seaming chuck, thereby causing rotation of the container body and container lid;

(c) a seaming roller; and

(d) a second drive connected to the seaming roller for positioning the seaming roller with respect to a circumferential edge of the lid, the first drive and the second drive being independently controllable from each other.

35. A machine according to claim 34 further comprising:

(e) a programmable controller for independently controlling the first and the second drive so that the position of the seaming roller with respect to the circumferential edge of the lid and the position of the seaming roller with respect to the container body and container lid during the rotation are coordinated to perform a seaming operation.

36. A method of seaming containers comprising the steps of:

(a) holding a container lid firmly against an end of a container body by using a seaming chuck;

(b) positioning a seaming roller with respect to a circumferential edge of the lid;

(c) rotating the seaming roller with respect to the chuck, container body and container lid while simultaneously and independently positioning the seaming roller with respect to the circumferential edge of the lid to seam the lid to the container body.

37. A method according to claim 36 wherein step (b) is performed by a first drive and step (c) is performed by a second drive, the method further comprising the step of:

(e) programming a controller to independently control the first and second drive so that the drives are coordinated to perform a seaming operation; and

(f) outputting control data from the controller to control the first and second drives.

38. A method according to claim 37 wherein steps (a)–(c) are performed by a seaming machine, the method further comprising the steps of:

(g) measuring seams of seamed container bodies and obtaining seam data;

(h) comparing the seam data to desired seam values, and

(i) adjusting the control data output by the controller based upon the results of the comparison while the machine is in operation, and without having to stop the machine.

39. A method according to claim 38 wherein the seam data is communicated to a location remote from where the seaming operation is performed and step (h) is performed at the remote location, the method further comprising the step of:

(j) sending adjustment instructions from the remote location to the controller, and using the adjustment instructions to perform step (i).

40. A method according to claim 37 wherein step (e) further comprises the step of programming the controller to output a plurality of different sets of instructions, each set of instructions relating to a specified container body size and including position instructions for the first drive and rotation instructions for the second drive.

41. A method according to claim 36 wherein in step (c), the seaming chuck is rotated, thereby causing rotation of the container body and lid with respect to the seaming roller.

42. A method according to claim 36 wherein step (b) further comprises adjustably positioning the seaming roller toward and away from a center axis of the container body, thereby positioning the seaming roller with respect to the circumferential edge of the lid.

* * * * *